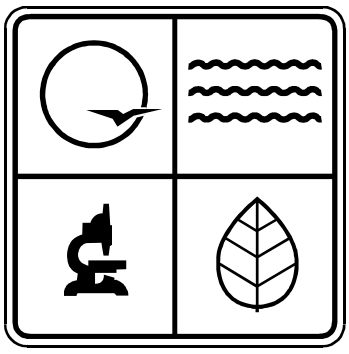
MISSOURI
WATER QUALITY REPORT

2004

MISSOURI DEPARTMENT OF NATURAL RESOURCES



WATER PROTECTION PROGRAM

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CHAPTER 1. EXECUTIVE SUMMARY

The Missouri Water Quality Report is published every two years. The report summarizes water quality issues and judges the degree of progress Missouri has made toward meeting Federal Clean Water Act goals. The water quality assessments made in this report will help direct future water quality management efforts to those waters most in need of restoration or protection.

WATER RESOURCES AND PROBLEMS

Missouri has an area of 69,000 square miles and a population of 5.60 million people, according to the 2000 census. About half of the human population is concentrated on opposite sides of the state in the Kansas City and St. Louis metro areas, leaving most of the state and its waters rural in nature. Surface and ground water in Missouri are quite varied in quantity and quality, corresponding closely with geology and land use.

Northern and Western Missouri

Northern and Western Missouri, originally prairie land, is now used primarily for crop and livestock production and is underlain by bedrock containing several relatively impermeable shale and clay layers. Surface waters are more turbid and are greatly affected by high rates of sediment deposition. These deposits, caused by soil erosion, result in poor aquatic habitat due to the fine, unstable materials of stream bottoms. About 7,600 miles of classified streams are affected by these effects or other types of degradation of aquatic habitat, such as modification of flow, or channelization.

Rivers and reservoirs used as drinking water supplies often contain herbicides. Drinking water standards for atrazine or health advisory levels for cyanazine are exceeded in some public water supplies served by reservoirs. Several other herbicides are occasionally found in drinking water reservoirs but at concentrations below health advisory levels.

The quality of ground waters in northern and western Missouri is also influenced by the geology of the area. Public water supply sources include reservoirs and wells. The wells obtain water from glacial drift deposits primarily in portions of north-central and western Missouri. Wells in western Missouri, south of Kansas City, obtain water from limestone aquifers except for the extreme western limits of Missouri near the state border with Kansas. Private water supplies are obtained from glacial drift deposits and from underlying limestone bedrock in portions of northwestern, central, eastern and northeastern Missouri. However, deep bedrock wells in many north-central and northwestern Missouri locations tap water supplies too mineralized for drinking water purposes. About one-third of private wells in this portion of Missouri exceed the drinking water standard for nitrate, and about 2 percent exceed drinking water standards for pesticides. This contamination is often caused by localized surface contamination of the wellhead and does not represent widespread contamination of the underground aquifer. Deeper aquifers are well protected from surface contamination by impermeable strata.

The Ozark Plateau

The Ozark Plateau, including the Springfield Plateau, is predominantly hilly topography. There are some very rugged portions as well as significant areas of gentle to almost flat landscape. The bedrock consisting of limestone, dolomite and sandstone yields ground water of excellent quality generally requiring no treatment and adequate in supply for most urban, industrial and other needs. The soil or overburden has developed by weathering from the bedrock formations and is generally 20 to 80 feet in thickness.

Some areas have extremely thin soils and other locations where weathering has been extensive have a thickness of 100 feet and more. The soil overburden has moderate to high infiltration rates which contribute to the recharge of ground water supplies. Ozark streams are generally clear with baseflows well sustained by many seeps and springs. Some streams and reservoirs in the Ozarks are becoming nutrient and algae enriched due to increasing human population and domestic animal production in some watersheds.

Ground water contamination risks are moderate to high due to the permeabilities of the soil and bedrock. Any number of surface activities, including agricultural and suburban-urban storm water and waste water disposal, mining, stormwater runoff, lawn care, and improper well and individual on-site wastewater disposal practices, pose threats to surface water and ground water quality. However, overall water quality remains good in large part due to the efforts by all parties to protect the aquifers.

Ground water is heavily relied upon for drinking water supply in this part of Missouri. Most municipalities in the southern half of the state rely on ground water for drinking water supply. The number of private drinking water wells statewide is not known but probably is between 100,000 and 250,000 with a greater number of these wells being south of the Missouri River. The major ground water concern is the often rapid and unfiltered transmission of contaminated surface runoff or leachate from some septic tanks, underground storage tanks, landfills, dumps, and liquid waste storage ponds, and animal production or processing wastes through fractures or sinkholes directly into potable aquifers. Properly cased wells into deep aquifers rarely encounter water quality problems, but shallow or improperly cased wells are at risk.

In the Joplin area, the shallow bedrock aquifer has elevated levels of sulfate and several heavy metals due to mineralization of ground water in flooded mines. Some private wells in this area exceed drinking water standards for lead or cadmium. Localized contamination of shallow private wells due to leaks, spills and improper disposal of industrial or commercial chemicals occurs in the larger metro areas of Springfield and Joplin.

The Mississippi Embayment

Missouri's southeastern corner is a large alluvial plain of the Mississippi River. Originally a vast system of wetlands, it has been drained and almost entirely converted to crop production. Almost all surface waters in the area are drainage ditches and are rated as only partially attaining beneficial uses because of degradation of aquatic habitat due to channelization. Channelization creates a homogenous, low quality aquatic habitat. Sloughing of the channel banks, which fills the channel bottoms, burying better habitat and leaving unstable substrate, is a problem.

Ground water is abundant due to high infiltration rates on these flat fields. Public water supplies that tap deeper aquifers provide good quality water, but shallow private wells commonly have nitrates and low levels of pesticides. The frequency of exceedence of drinking water standards for nitrates and pesticides in private wells is similar to northern Missouri, about 30 percent and 2 percent, respectively.

Alluvial Aquifers

The remaining major aquifer is the alluvial aquifer system of the major rivers of the state. In northern Missouri, where surface and deep aquifer supplies are unreliable, many towns depend on the alluvial aquifer of a large nearby stream. Landfills and industrial land use in Kansas City and St. Louis have historically been located on river floodplains and have caused local contamination of the Mississippi, Missouri and Meramec river aquifers in St. Louis and the Missouri River aquifer in Kansas City. Some municipal water supplies have been affected.

WATER POLLUTION CONTROL ACTIVITIES

Authority for enforcement of the Missouri Clean Water Law and for state regulations concerning water pollution resides with the Department of Natural Resources, Water Protection and Soil Conservation Division. Authority for the regulation of pesticides rests with the Missouri Department of Agriculture.

Point Source Controls

The number of miles of classified streams judged to be impaired by point source wastewater discharges is basically similar to the estimate from 1984, when statewide data on stream quality first became available. In 1984, 105 miles of classified stream were judged to be impaired by domestic or industrial wastewaters. Domestic and industrial discharges include wastewaters from cities, subdivisions, apartment complexes, mobile home parks, businesses and industries. Stream miles impaired by point source discharges in more recent year were 91 miles in 1998, 93 miles in 2000, 104 miles in 2002, and 101 miles in 2004.

Hog and poultry production in confined animal feeding operations (CAFOs) are now major industries in Missouri. The large amount of animal waste generated at these facilities requires proper management to prevent water pollution. CAFOs are incorporated into the point source permit program, consistent with federal requirements.

Concern over eutrophication of large, recreationally reservoirs led to changes in the state regulations for discharges of wastewater. These regulations impose phosphorus concentration limits on most wastewater discharges in the Table Rock Reservoir and Lake Taneycomo watersheds.

Nonpoint Source Controls

Control of nonpoint water pollution sources such as runoff from farms, cities, mining areas and construction sites is still essentially a voluntary program. Regulations are in place to prevent leakage from underground storage tanks and for the secondary containment of bulk agricultural chemical storage sites. Large sand and gravel mining operations require a general permit for stormwater and smaller operations have been provided with guidelines for best management practices (BMPs), in addition to the 404 permit required of all sand and gravel operations. Stormwater runoff discharge permits are issued for construction sites and other areas with more than one acre of bared ground. The Water Pollution Control Branch recently reduced this size to one from five acres. About 25% of all permits now issued by the Water Pollution Control Branch are stormwater permits on land disturbance activities.

Control of many nonpoint sources, such as agricultural erosion from cropland and pasture, runoff of fertilizer, pesticides and animal waste, are addressed by Missouri's voluntary nonpoint source management program. This program works with federal, state and local governments, universities, private groups, and individual landowners to implement watershed projects that employ nonpoint source control practices and often monitor water quality results.

Programs with dedicated funding sources have worked best. A tax on coal has funded reclamation of abandoned coal mined lands nationwide. Sixteen years of such reclamation in Missouri has reduced the number of stream miles impaired by acid mine drainage from about 100 down to three. A state sales tax for soil erosion control started providing funds for watershed level soil erosion control programs in 1985. This program, coupled with federal soil conservation programs, is reducing soil erosion in Missouri based on the findings of periodic USDA National Resource Inventories.

STATE CONCERNS

- Channelization has caused aquatic habitat degradation in 17 percent of Missouri's streams. Large channelization projects affecting many miles of streams are no longer occurring but many short projects still occur and continue to reduce the number of miles of natural stream channels statewide. Streams that were channelized many years ago still provide poor aquatic habitat, and these streams still contribute to flooding, high water velocities and streambank erosion as they try to recreate their natural sinuosity.

- Eutrophication of large, recreationally important reservoirs continues to be a concern. Heavy residential development around portions of Lake of the Ozarks and Table Rock Lake threatens water quality in many small coves and shoreline areas. Water clarity in the main portion of Table Rock Lake, which was historically very clear, has apparently been declining based on observations by the University of Missouri. The large size of these lakes and rugged local topography make centralized collection and treatment systems for waste water difficult. Nutrient problems from waste water treatment plants and septic tanks are being aggravated by increasing confined animal production in the watersheds of these lakes. Recent imposition of phosphorus limits on most wastewater discharges to Table Rock Lake has resulted in improved conditions in the James River arm of the lake.

- Mercury levels in fish in Missouri appear to be increasing over time. Re-evaluation of human health risk factors for mercury has led the Missouri Department of Health & Senior Services to issue an advisory against consumption of Largemouth bass greater than 15 inches in length for children 12 years of age and under, pregnant women and women who may become pregnant. The advisory pertains to all waters in Missouri.

- Abandoned lead-zinc mines and their tailings continue to impact waters decades after mining has ceased.

Missouri's Superfund program is addressing some of these concerns. But long-term impacts are expected to remain. Although new mineral extraction operations would be managed under state permits, areas of the state that are very sensitive to disruption are being investigated for mining potential.

- Additional ground water protection measures are needed. Missouri now has in place programs that register and inspect underground storage tanks and oversee the cleanup of leaking underground tank sites, programs for wellhead protection, sealing of abandoned wells and closing of hazardous waste sites. A complete ground water protection program would also include a ground water monitoring network and educational programs for those involved in the application of farm chemicals, transporters of hazardous materials and the general public.

- There are 370 Class I confined animal feeding operations (CAFOs) located in Missouri. These are operations containing, for example, at least 1,000 beef cattle, 2,500 large swine, or 100,000 broiler chickens. These facilities generate large amounts of animal manure and have the potential to cause serious water pollution problems. We are also concerned by cumulative impacts of numerous small animal production facilities. However, the Department of Natural Resources is no longer issuing Letters of Approval for smaller facilities, meaning that they will be largely unregulated.

- The data on fish that have been collected and the data on invertebrates that are still being collected indicate that many of these communities throughout the state are suffering from degraded quality of aquatic habitat. Physical alterations of the channel, alterations in stream flow patterns, degraded conditions in the riparian zone, and upland land use changes are all believed to be significant contributors to this problem.

- Throughout all urban areas of the state, continuing suburban development impacts streams by the direct loss of stream channels, by shortening, culverting, and removing riparian areas, and by other impacts associated with development and increased storm water flows.

TABLE 1. BENEFICIAL USE SUPPORT STATUS OF MISSOURI CLASSIFIED* WATERS

STATUS	STREAM MILES	%	LAKE ACRES	%
Full Support	11,120.1	50	209,368	71
Not Supported	10,899.8	49	84,321	29
Not Assessed	183.2	1	70	.02

∉ Numbers in Table 1 updated March 17, 2004.

Full Support: Water quality meets the needs of all uses that Missouri recognizes for a particular waterbody such as protection of fish and other aquatic life (the water quality does not interfere with the ability of aquatic life to live, feed and reproduce), livestock and wildlife watering (the water will not cause disease or injury to livestock and wildlife using the water for drinking), drinking water supply (the water meets all state and federal standards as a drinking water supply source water), swimming (the water will not cause disease or injury to swimmers or others participating in water-based recreation who may accidentally swallow small amounts of water), irrigation (the water will not cause disease or injury to crops) or industrial water supply (the water will not cause excessive problems with corrosivity or mineral deposits in industrial piping and boilers), fish consumption (fish are safe to eat) and boating and canoeing.

Not Supported: Water quality is seriously affected to the point that at least one recognized use of the waterbody has been lost.

Not Assessed: Streams in some urban and rural watersheds are believed to be significantly different in land use from monitored streams in their region so that their quality cannot be accurately inferred from monitored streams.

NOTE: In this report, "impaired" waters refers to waters rated as not supported.

* There are 22,172 miles of classified streams (permanently flowing streams or streams which maintain permanent pools during dry weather) and approximately 30,000 miles of unclassified streams (streams which are without water during dry weather). There are 293,760 surface acres of classified lakes. The number of surface acres of small unclassified lakes has not been estimated.

TABLE 1A. INDIVIDUAL USE SUPPORT SUMMARY FOR CLASSIFIED WATERS*

BENEFICIAL USE	SIZE ASSESSED	FULL SUPPORT	NON-SUPPORT	NOT ASSESSED	USE NOT APPLICABLE
STREAMS (MILES)					
AQUATIC LIFE	22,015.9	11,577.5	10,438.4	187.2	0
FISH CONSUMPTION	1,750.3	1,072.5	677.8	20,452.8	0
SWIMMING	5,489.4	5,468.9	20.5	207.1	16,506.6
DRINKING WATER	3,234.7	3,024.2	210.5	0	18,968.4
LAKES (ACRES)					
AQUATIC LIFE	293,249	291,469	1730	70	0
FISH CONSUMPTION	293,138	215,388	44,395	181	0
SWIMMING	261,847	218,565	43,282	0	31,472
DRINKING WATER	99,871	87,890	503	0	193,448

*A complete list of Missouri's classified waters, their assessments for all uses, and their associated contaminants and sources, which was used in the compilation of Tables 1-3, will be made available at www.dnr.mo.gov.

TABLE 2. MAJOR WATER POLLUTION SOURCES IN MISSOURI CLASSIFIED WATERS
(Stream Miles or Lake Acres Impaired)

Source	Stream Miles Impaired	Percent of Total Miles	Lake Acres Impaired	Percent of Total Acres
Agriculture	7,640.8	34	44,138	15
Crop Production	7,623	34	44,138	15
Grazing	8.5	*	--	--
Hydromodification	3,923.3	18	13,730	5
Channelization	3,829.3	17	--	--
Flow Regulation/Modific.	39	*	12,730	4
Streambank Mod./Destab.	21	*	--	--
Upstream Impoundment	30	*	1,000	*
Atmospheric Deposition	785	4	26,305	9
Natural Sources	180.5	1	--	--
Mining	176.3	1	--	--
Tailings	144.9	1	--	--
Other Mining Activities	36.5	*	--	--
Municipal and other Domestic Point Sources	85.6	*	43,105	15
Urban Runoff and Construction	56.3	*	18	*

Industrial Point Sources	15.7	*	--	--
Unknown	15.5	*	182	*
Recreational Activities	7	*	--	--

* less than 1 %

TABLE 3. MAJOR CONTAMINANTS IN MISSOURI CLASSIFIED WATERS

Contaminant	Stream Miles Impaired	% of Total Miles	Lake Acres Impaired	% of Total Acres
Habitat Degradation	10,162.2	46	--	--
Metals	1,138.6	5	36,305	12
Mercury	782	4	26,305	9
Lead	45	*	--	--
Zinc	42	*	--	--
Cadmium	31	*	--	--
Sediment	195.9	1	--	--
Organic Enrichment /Low D.O.	96	*	2,730	1
Unknown	43	*	--	--
TDS: Sulfate, Chloride	40	*	18	*
Ammonia	29.1	*	--	--
pH	27	*	--	--
Pesticides	24	*	380	*
Bacteria	16	*	137	*
Nutrients	12.4	*	43,758	15
Suspended Solids	7.6	*	--	--
Organic Compounds	2.8	*	--	--
Thermal Modification	1.6	*	--	--
Chlorine	0.4	*	--	--
Flow Alterations	--	--	1000	*

* less than 1 %.

NOTE: Many stream miles in Missouri are affected by more than one pollution source or pollutant; therefore, total miles/acres in Tables 2 and 3 can exceed miles/acres in Table 1.

CHAPTER 2. MISSOURI AND ITS WATER RESOURCES

Missouri has an area of 69,000 square miles and a population of 5.60 million people. About half of the population is concentrated along the border areas on opposite sides of the state in the Kansas City and St. Louis metro areas. Population as well as industrial and commercial activity in major urban areas has remained relatively stable for the past few decades. Patterns of rural land use have changed greatly in some areas, particularly residential development around the larger cities, recreational development adjoining Lake Taneycomo and the eastern ends of Lake of the Ozarks and Table Rock Lake and the increasing development of large confined animal feeding operations in north central and southwestern Missouri.

Missouri has an extensive stream network that includes over 22,000 miles of classified streams and over 293,000 surface acres in its 457 classified lakes. Three distinct regions exist within the state's boundaries, and the particular geology and land use of each affect water quality. These areas are a prairie region, which is rolling land predominantly used for row crop and pasture; the Ozarks, a hilly area that is mostly pasture and forest; and the Bootheel, a flat alluvial plain adjoining the Mississippi River in southeast Missouri, which is used mainly for row crop production.

Missouri's Water Quality Standards (10 CSR 20-7.031) provide the names and locations of all classified streams and lakes. This state regulation defines over 3,600 individual stream and river segments and 457 lakes, lists which beneficial uses are assigned to each of these waters, and defines the level of water quality necessary to meet each of these uses.

The remaining waters of the state--such as those in the upper portions of the stream network that do not have permanently flowing or standing water, and a number of small lakes--are not listed in the Missouri Water Quality Standards and do not have beneficial uses assigned to them. These unclassified waters are protected by the general criteria in the Water Quality Standards. The general criteria say that these waters must be free from such aesthetic problems as demolition debris, trash, tires, odor, discoloration or the presence of objectionable floating or deposited material. The general criteria also say the waters must be free from conditions harmful to livestock or aquatic life.

TABLE 4. MISSOURI'S WATER RESOURCES

Missouri Population (million people)	5.60
Surface Area (square miles)	69,000
Number of Four-Digit HUCs*	12
Number of Eight-Digit HUCs*	66
Number of Twelve-Digit HUCs*	1,965**
Classified Stream Miles	22,203
Unclassified Stream Miles	82,126
Number of Classified Lakes	457
Total Classified Lake Surface Area (acres)	293,759
Freshwater Wetlands Area (acres)	Less than 480,000***

*HUC (Hydrological Unit of Classification): A hierarchical system of watershed delineation, developed by USGS. The system describes scales ranging from major continental basins (two digits) to small localdrainages (14 digits).
** The NRCS is now working on the 11th version of the 12 digit HUC delineation for the United States. This version is not yet completed and the final number of 12 digit HUCs could be slightly different.
*** Estimate from Epperson, J.E. 1992, "Missouri Wetlands: A Vanishing Resource", Missouri Dept. of Natural Resources, Division of Geology and Land Survey, Water Resources Report No.39.

CHAPTER 3. SURFACE WATER ASSESSMENT

DESCRIPTION OF MISSOURI'S CURRENT WATER QUALITY MONITORING PROGRAM

Purpose

The major purposes of the water quality monitoring program are (1) to characterize background or reference water quality conditions; (2) to better understand daily, flow event and seasonal water quality variations and their underlying processes; (3) to characterize aquatic biological communities and habitats and to distinguish between the impacts of water chemistry and habitat quality; (4) to assess time trends in water quality; (5) to characterize local and regional impacts of point and nonpoint source discharges on water quality; (6) to check for compliance with water quality standards or wastewater permit limits, (7) to aid in developing TMDLs to prescribe acceptable limits of pollutants to be discharged; and (8) to support development of strategies to return impaired waters to compliance with water quality standards. All of these objectives are statewide in scope.

Coordination with Other Monitoring Efforts in Missouri

The department cooperates with other agencies in performing special water quality studies. In 1998, a multi-agency task force including the Missouri Department of Natural Resources, Missouri Department of Conservation, U.S. Environmental Protection Agency, the U.S. Geological Survey, U.S. Forest Service, U.S.D.A. Natural Resources Conservation Service, and University of Missouri convened to develop an outline of a statewide aquatic resources monitoring plan, define partnership roles in this monitoring plan and discuss the kind of research needed to further this new monitoring effort. The first major product of this work group was an agreement to initiate in 2001 a cooperative statewide aquatic invertebrate and fish monitoring program by the Missouri Department of Conservation and the Department of Natural Resources. The fish monitoring program has since been discontinued, and the invertebrate monitoring program has not yet been implemented. The work group plans to meet again in the future.

To maximize efficiency, the department routinely coordinates its monitoring activities to avoid overlap with other agencies and provide and receive interagency input on monitoring study design. Data from other sources is used for meeting the same objectives as department sponsored monitoring. The agencies most often involved are the U.S. Geological Survey (USGS), the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency (EPA), the Missouri Department of Conservation (MDC), the USDA/Agricultural Research Service (ARS) and the Missouri Department of Health & Senior Services. However, the department also tracks the monitoring efforts of the National Park Service (NPS), the U.S. Forest Service (USFS), several of the state's larger cities, the states of Arkansas, Kansas, Iowa, and Illinois, and graduate level research conducted at universities within Missouri. The department also uses monitoring data acquired by wastewater dischargers as a condition of discharge permits issued by the department. The department began using data collected by volunteers that have passed Quality Assurance/Quality Control (QA/QC) tests in 1995.

Networks and Programs

1. Fixed Station Network

   A. Objective: To better characterize background or reference water quality conditions, to better understand daily, flow event and seasonal water quality variations and their underlying processes, to assess time trends and to check for compliance with water quality standards.

   B. Design Methodology: Sites were chosen based on one of the following criteria:
      - site is believed to have water quality representative of many neighboring streams of similar size due to similarity in watershed geology, hydrology and land use, and the absence of any impact from a local point or discrete nonpoint water pollution source.
      - site is downstream of a significant point source or localized nonpoint source area.

C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:

- USGS/DNR cooperative network: 58 sites statewide, horizontal and vertical integrated grab samples 6-12 times per year with major ions, nutrient ions, temperature, pH, dissolved oxygen, specific conductance, suspended solids, flow; heavy metals 2-4 times annually at all sites, pesticides 6 times annually at 8 sites. DNR chemical monitoring of 24 sites 4 times per year for major ions, nutrient ions, temperature, pH, dissolved oxygen, specific conductance. DNR raw water sampling of public drinking water reservoirs: grab samples at nine sites, 4 times/year, for 10 common agricultural herbicides. UMC/DNR lake monitoring network: about 100 lakes monitored during the summer and about 12 monitored spring through fall for nutrients, chlorophyll, turbidity and suspended solids.
- DNR routine monitoring of finished public drinking water supplies for bacteria and trace contaminants.
- Routine bacterial monitoring of swimming beaches at Missouri state parks during the recreational season by the department's Division of State Parks.
- Routine monitoring of sediment quality at 25 fixed sites, on a five-year rotating basis, plus 10 discretionary sites annually. All sites are monitored for several heavy metals and organic contaminants. A pore water sample is analyzed for ammonia and a Microtox toxicity test on the pore water is performed.

2. Intensive Surveys

A. Objective: To characterize the water quality impacts from a specific pollutant source area.

B. Design Methodology: Determination of contaminants of concern based on previous water quality studies, effluent sampling and/or NPDES permit applications, use of multiple sampling stations downstream and upstream (if appropriate). If contaminants of concern have significant seasonal or daily variation, season of the year and time of day variation must be accounted for in sampling design. These studies would also require multiple samples per site over a relatively short time frame (e.g., 6-8 visits over a 2-3 day period or 10-15 visits over a 2-3 year period).

C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
Missouri Department of Natural Resources conducts or contracts for 10-15 special studies annually. Each study would have multiple sampling sites. Number of sites, sampling frequency and parameters vary greatly depending on the study.

3. Toxics Monitoring Program

Monitoring of toxics is not a separable part of the monitoring program. The fixed station network and many of our intensive studies monitor for toxic chemicals. In addition, major municipal and industrial dischargers must monitor for toxicity in their effluents as a condition of their NPDES permits.

4. Biological Monitoring Program

The Missouri Department of Natural Resources has developed a monitoring program for aquatic invertebrates that is proving very useful for characterizing the health of aquatic biological communities in Missouri. Forty-five reference streams were identified across the state, and were used to develop criteria describing reference communities of macroinvertebrates for different ecological regions. At least 50 stream sites are sampled annually, generally chosen to support the formation of the 303(d) list and the creation of TMDLs. Sampling results and data analysis are available from a central database. A long-term objective of the program is to establish a fixed statewide network of biological monitoring stations in order to monitor large-scale trends. Fish sampling must also be a part of an effective long-term biological monitoring program.

The department contracted with the U.S. Geological Survey in 2001 to conduct a study of aquatic invertebrate communities on the Missouri River. The study has been conducted and is being prepared. The department sees this work as the first of several steps by which it will promote the better understanding of fish and invertebrate communities of large rivers, and ultimately the development of biological criteria for the Missouri and Mississippi rivers.

5. Fish Tissue

   A. Objective: Measure levels of bioaccumlative toxicants in fish.

   B. Design Methodology. Sites were chosen based on one of the following criteria:
      - site is believed to have water and sediment quality representative of many neighboring streams of similar size due to similarity in geology, hydrology and land use, and the absence of any known impact from a local point source or discrete nonpoint water pollution source.
      - site is downstream of a significant point source or localized nonpoint source area.

   C. Number of Sites, Sampling Methods, Sampling Frequency, Parameters:
      15 sites, fish taken by electroshocking, ideally a sample is composed of five whole carp *Cyprinis carpio* of equal size (fish of approximately 18" length are preferred). Sites are sampled once every two years and are analyzed for several chlorinated hydrocarbon insecticides, PCBs, lead, cadmium, mercury and fat content.

Laboratory Analytical Support

Laboratories Used:
- USGS/DNR Cooperative Fixed Station Network: USGS Lab, Denver, Colorado
- Crowder College Network: Crowder College, Neosho, Missouri
- DNR Public Drinking Water Reservoir Network: Missouri DNR Environmental Lab
- Intensive Surveys: Varies, many are done by Missouri DNR Environmental Lab
- Toxicity Testing of Effluents: many commercial labs
- Biological Criteria for Aquatic Invertebrates: Missouri DNR Environmental Lab and University of Missouri, Columbia
- Fish Tissue: USEPA Region VII Lab, Kansas City, Kansas and miscellaneous contract labs (Missouri Department of Conservation)
- NPDES self-monitoring: commercial labs
- DNR Public Drinking Water Monitoring: Missouri Department of Natural Resources and commercial labs
- Agricultural Research Service: ARS lab

Quality Assurance/Quality Control Program (QA/QC)

Missouri and Region 7 EPA have completed a Total Quality Management Plan. All environmental data generated directly by the department or through contracts funded by the department or EPA will require a quality assurance project plan (QAPP) following the QAR5 guidance.

Data Storage and Management

The department retrieves raw data from the USGS database, NWIS, and numerous state, federal and municipal sources. This data is imported into the Missouri state computer system for storage and statistical analysis. The department maintains a good deal of water quality data in a number of ACCESS databases. Data in these files comes from MDNR's own monitoring efforts and a wide array of other public and private sources.

The department is now working to batch load water quality data from our ACCESS files into the new STORET. Beginning in 1999, the department began linking many separate databases pertaining to water quality, other environmental data and information on regulated facilities via ACCESS software and importing this data into a GIS (ArcView) environment. The majority of the work has been completed, but new data is received on a regular basis that enters this process.

The Missouri Department of Natural Resources has developed a database that provides access to the raw data and analysis of all quantitative invertebrate sampling it has performed. The Missouri Department of Conservation is also developing an invertebrate database, with the intention that it is compatible with that of the DNR. The Department of Conservation also has plans to create a fisheries database that would contain community-level data.

Training and Support of Volunteer Monitoring

Two volunteer monitoring programs are now generating water quality data in Missouri. The first is a cooperative program between the Department of Natural Resources, the University of Missouri, and volunteers, who monitor approximately 16 lakes, including Lake Taneycomo, Table Rock Lake, and several lakes in the Kansas City area. Data from this program is used by the University as part of a long-term study on the limnology of Midwestern reservoirs.

The second program involves volunteers who monitor water quality of streams throughout Missouri. The Volunteer Water Quality Monitoring Program is a cooperative project of the Department of Natural Resources, the Department of Conservation, and the Conservation Federation of Missouri and is a subset of the Missouri Stream Team Program. By the end of 2003, just over 3000 citizen volunteers had attended at least one training workshop. After the introductory class, many proceeded on to at least one more class of higher level training; Levels 1, 2, 3, and 4. Each level of training is a prerequisite for the next higher level, as is appropriate data submission. Levels 2, 3, and the newest level, 4 (piloted in 2003) represent increasingly higher quality assurance/quality control stringency. Of those completing an introductory course, 383 (about 13%) proceeded through Level 1 and successfully attained a ranking of Level 2. Seventy-two of those went on to pass a Level 3 quality assurance/quality control audit. Data submitted by Level 2- and Level 3-ranked volunteers can be used for more than baseline and trend data or locating problems. It can supplement agency-collected data and is used in the department's water quality assessment database.

In the 2002 and 2003 calendar years specifically, 600 citizens were trained in at least one workshop. During that period of time, 238 individuals continued on in the training series; 73 of them attained a Level 2 ranking and 18 went on to pass Level 3 sampling audits. Level 2 and 3 monitors submitted 187 sets of macroinvertebrate data from 114 different stream sites during 2002 and 2003. In that same time period, they submitted 636 sets of water chemistry data from 189 sites. Four volunteers participated in the pilot Level 4 in 2003, through which they attended professional-level training on sample collection and preservation, and chain-of-custody procedures. Three Level 4 sampling events took place in 2003 on four sites on Hinkson Creek in Boone County. Water chemistry data from these events was generated from on-site analysis of some parameters and State Environmental Laboratory analysis of grab samples for other parameters, providing even higher data credibility.

Data Interpretation and Communication

Missouri now uses an ACCESS database for tracking and reporting waterbody use attainment information. An EPA contractor, RTI, completed geo-referencing of Missouri's classified waters in 1998. The stream and lake network of the state, water quality standards information, the locations of permitted wastewater discharges and other potential pollutant sources and information describing them can now all be viewed within a GIS (ArcView) environment.

The department has a variety of water quality information available on its web site. This information includes, or will include, TMDLs, the 305(b) report and 303(d) list, a list of all classified waters of Missouri that includes monitoring and assessment information on each water, water quality information sheets for 303(d) candidate waters, and watershed information sheets from various watersheds around the state.

Sharing Data with the Public

Water quality data accessibility is easy. Contact the Water Protection Program for more information.

1. Requests for very general information on water quality may be made by calling 1-800-361-4827. They may be filled by the 305(b) report, pamphlets or fact sheets. Much of this information, plus information on Missouri's 303(d) list and completed Total Maximum Daily Load (TMDL) studies, is also available on the Internet at:

   http://www.dnr.state.mo.us/wpscd/wpcp/homewpcp.htm

2. Some requests may be for information on a specific waterbody or for more detailed information on a specific topic that might include summaries of major studies or available data. These requests are usually filled by the Missouri Watershed Information Sheets, documents that describe Missouri's watersheds and provide information on land use, hydrogeology, stream flow and water quality issues and concerns in

each.

3. More specific requests may require published reports or water quality data files. If the report or data was generated by the department, it can be sent to the requestor through electronic mail, or regular mail (a hard copy for small reports and data files, or floppy or compact disks for larger data files). Alternatively, the requestor may visit the department office at 205 Jefferson Street in Jefferson City and view the files directly. If the report or data file did not originate with the department, the request is sent to the organization that published the report or data.

Requests for more specific water quality information, or requests to view water quality data files, should be sent to:

Missouri Department of Natural Resources
Water Protection Program
ATTN: John Ford
P.O. Box 176
Jefferson City, MO 65102-0176
Phone: (573) 751-7024 Fax: (573) 526-5797
Email: john.ford@dnr.mo.gov

Monitoring Program Evaluation

The water quality monitoring program within the department has traditionally focused on the chemical characterization of water quality in both those streams that are free of, and subject to, point source waste water discharges. While the monitoring has been able to keep pace with our more critical point source assessment needs and has done a good job of characterizing regional water quality unimpaired by point source discharges, the size and scope of the department's monitoring has fallen far short of the state's information needs. The advent of large confined animal feeding operations (CAFOs) in Missouri, concern over eutrophication of our large recreational lakes and continuing urban sprawl, among other problems, have produced questions our present monitoring program is incapable of answering.

PLAN FOR ACHIEVING COMPREHENSIVE ASSESSMENTS

The department, in conjunction with the EPA and with input from various stakeholders, is beginning the process of developing a long-term Monitoring Strategy for the state. This plan will take into account Missouri's current and future monitoring needs and will build on Missouri's current monitoring program to make sure that available resources are used in a way that will meet those needs as much as possible.

ASSESSMENT METHODOLOGY

This section describes the procedures used by the Missouri Department of Natural Resources to rate the quality of Missouri's waters.

Water quality is judged by its conformance with Missouri's Water Quality Standards. These standards were first implemented for all Missouri streams and a few large lakes in 1970 and are revised every three years. These standards now list over 22,000 miles of classified streams and 457 significant public lakes representing 293,759 surface acres of water, and the uses for which these waters are protected. These standards also list the maximum allowable concentrations of chemicals and bacteria in these waters.

The table below lists the various uses of Missouri's waters and the portions of state waters that are protected for each use.

TABLE 5. MISSOURI WATERS PROTECTED FOR VARIOUS USES

Designated Use	Stream Miles	% of Total	Lake Acres	% of Total
Protection of Aquatic Life and Fish Consumption	22,203.1	100	293,759	100
Subset: Warm-Water Fishery	19,080.2	86	282,575	96
Cool-Water Fishery*	2,756.7	13	0	0
Cold-Water Fishery**	228.5	1	10,730	4
Livestock and Wildlife Watering	22,203.1	100	293,759	100
Whole-Body-Contact Recreation	5,696.5	26	261,917	89
Boating	6,953.7	31	234,990	80
Drinking Water Supply	3,234.7	15	100,311	34
Industrial	1,257.5	6	7,003	2
Non-degradation: Outstanding National	171.2			
State Resource Waters	192.5***			
Irrigation	4,025.5	18	0	0
Total Classified Waters in Missouri	22,203.1		293,759	

* Smallmouth Bass, Rock Bass
** Trout
*** Outstanding State Resource Waters also include 270 acres of marsh in 3 locations.

Classified waters of Missouri are all permanently flowing streams or streams with permanent pools. All classified waters of the state and all significant public lakes are classified for protection of aquatic life, livestock and wildlife watering and fish consumption by humans. The Water Quality Standards for these uses set the maximum allowable concentrations for 110 chemicals in these waters. A subset of these waters classified for drinking water supply have maximum allowable concentrations for an additional 20 chemicals in the Standards. Waters protected for whole-body-contact recreation such as swimming or water skiing also have a maximum allowable bacteria standard.

Missouri's Water Quality Standards also contain narrative criteria. These standards are not numbers but general statements about the department's expectations for waters of the state. These standards require waters to be free of objectional odors, color, turbidity, trash, floating materials or bottom deposits and to be free of conditions harmful to aquatic life such as high water temperature, low dissolved oxygen or chemical toxicity. Importantly, these standards apply not just to the classified waters, but to all waters of the state including the small intermittent streams that only carry water during and shortly after rainfall or snow melt.

Table 6 below shows how the chemical and bacterial standards and aquatic biological information are used to rate the quality of Missouri's waters for the 2004 305(b) report. The methods contained in Table 6 will undergo revision before being used in the formulation of Missouri's 2004 303(d) list, to reflect directives recently communicated by the Missouri Clean Water Commission.

Table 6. METHODS FOR ASSESSING COMPLIANCE WITH WATER QUALITY STANDARDS

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE*	COMPLIANCE WITH WATER QUALITY STANDARDS
Overall use protection (all beneficial uses)	No data--evaluated based on similar land use/ geology as stream with water quality data.		Given same rating as monitored stream with same land use and geology.
	Visual observation of stream and qualitative evaluation of aquatic macroinvertebrates.	1	Full: Stream appearance and aquatic invertebrates typical of reference streams in this region of the state. Non-Attainment: Presence of objectionable or unsightly color, odor, turbidity, bottom deposits, oil, scum, floating or suspended debris, or the presence of substances in sufficient amounts to prevent full maintenance of beneficial uses, or a reduction or alteration in the diversity and/or integrity of the aquatic community.
Protection of Aquatic Life	Chemical (toxics)	1-2	Full: No more than 1 exceedence of acute or chronic criterion in 3 years. Non-Attainment: More than 1 exceedence of acute or chronic criterion in 3 years.**** NOTE: The chronic criterion must be exceeded for four consecutive days in order for it to be considered an exceedence.
Protection of Aquatic Life	Chemical (conventional)	1-2	Full: Less than 10% of all samples exceed criterion. Non-Attainment: 10% or more of all samples exceed criterion.****
Protection of Aquatic Life	Biological	3	Full: Fauna very similar to regional reference streams. Non-Attainment: Diversity or number of intolerant taxa significantly less than reference streams.
Protection of Aquatic Life	Toxicity testing of effluent	2	Full: No more than one test result of statistically significant mortality in either of two test species at the AEC*** or the AEC must be less than 30% of the LC_{50}** for both test species, in a 3-year period. Non-Attainment: Conditions for full attainment not met.
Protection of Aquatic Life	Toxicity testing of streams or lakes	3	Full: No more than one test result of statistically significant deviation from controls of acute test endpoints in at least two representative species, in a 3-year period. Non-Attainment: Conditions for full attainment not met. [Statistically significant mortality in at least one of two representative test species]
Fish Consumption	Chemicals (water) Chemicals (tissue)	1-2	Full: Water quality criteria not exceeded as a long-term average; or less than 10% of all samples

BENEFICIAL USES	DATA TYPE	DATA QUALITY CODE*	COMPLIANCE WITH WATER QUALITY STANDARDS
			exceed water quality standard; fish consumption advisories allow typical or average fish consumption rates for all commonly eaten species. Non-Attainment: Water quality criteria exceeded as long-term average, or 10% or more of all samples exceed water quality standard;**** or consumption banned or less than typical consumption rate allowed for at least one commonly eaten species.
Drinking Water Supply	Physical, chemical (nutrients)	1-2	Full: Very little loss of lake volume due to sedimentation, low levels of nutrients, no history of taste or odor problems due to algae. Non-Attainment: Water supply has chronic water shortage due to loss of storage volume to sedimentation, or frequent taste and odor problems, or supply causes infrequent gastrointestinal problems in users.
Drinking Water Supply	Chemical (toxics, raw water)	1-2	Full: Mean values do not exceed water quality standards. Non-Attainment: One or more contaminants have mean values in excess of water quality criteria.
Drinking Water Supply	Chemical (Iron, Manganese, Total Dissolved Solids, Raw Water)	1-2	Full: Mean values do not exceed water quality standard. Non-Attainment: Mean values exceed water quality standard.
Drinking Water Supply	Chemical (toxics, finished water)	1-2	Full: No MCLs^{+} or Water Quality Standards criteria exceeded or significant taste and odor problems using only conventional treatment (sedimentation-disinfection). Non-Attainment: At least one contaminant has annual average exceeding MCL or Water Quality Standards criterion, or supply has been closed during the past 2 years due to contamination of raw water entering the plant. NOTE: water quality problems caused by the drinking water treatment process such as the formation of Trihalomethanes (THMs) are not included.
Whole-Body-Contact Recreation	Fecal Coliform count	1-2	Full: Water Quality Standards not exceeded as a geometric mean for samples collected during the recreation season and at times not influenced by storm water flows. Non-Attainment: Geometric mean of all samples collected during recreation season at times not influenced by storm water flows exceeds Water Quality Standard criterion.
Irrigation, Livestock and Wildlife Water	Chemical (boron, cobalt)	1-2	Full: Mean value does not exceed water quality criteria. Non-Attainment: Mean value exceeds water quality criteria.

* Data quality codes have been established by EPA to rate the quality and quantity of data from a specific source. Level One data is the lowest level of useable data and includes infrequent chemical monitoring or qualitative biological monitoring. Level Two data would include intensive water chemistry studies, long-term water chemistry monitoring sites and fish tissue analysis. Levels Three and Four are for detailed biological studies of fish, aquatic invertebrates and toxicity testing of waters.

** LC_{50} The concentration of a contaminant that kills 50% of test organisms.

*** AEC = Acceptable Effluent Concentration. This is the percentage of effluent in a solution of effluent at the effluent design (max.) Flow mixed with 2.5% of the $7Q_{10}$ low flow of the receiving stream. This would simulate the instream toxicity potential of the discharge during dry weather.

**** All individual exceedences of a water quality criterion will be treated equally regardless of degree or magnitude of the exceedence**.**

+ MCL= Maximum Contaminant Level, the maximum level allowed for a chemical in finished drinking water.

WATER QUALITY ASSESSMENT

Table 7. Summary of Fully Supporting, Threatened and Impaired Waters

Degree of Use Support	Evaluated Streams Miles	Monitored Streams Miles	Total Stream Miles Assessed	Evaluated Lake Acres	Monitored Lake Acres	Total Lake Acres Assessed
Fully Supporting All Assessed Uses	**8,344.8**	**2,775.3**	**11,120.1**	**46,230**	**163,138**	**209,368**
Impaired For One or More Uses	**7,443.7**	**3,456.1**	**10,899.8**	**1,914**	**82,407**	**84,321**
TOTAL ASSESSED	15,788.5	6,231.4	**22,019.9**	48,144	245,545	**293,689**
TOTAL UNASSESSED			**183.2**			**70**

Monitored waters are those where water quality data has been collected in the last five years. Approximately 28% of all classified stream miles and 84% of all classified lake acres are considered to be monitored. The department only considers monitored waters in the development of the state Section 303(d) list.

Evaluated waters are those which have not been monitored in the last five years but have geology and land use similar to nearby monitored waters and whose water quality assessment is assumed to be the same as those nearby monitored waters. 71% of all classified stream miles and 16% of all classified lake acres are considered to be evaluated.

Unassessed waters are those that are not monitored directly nor do they have nearby monitored waters with similar geology and land use. Thus, these represent the classified waters in the state for which we are unable to make an accurate assessment of their compliance with water quality standards and Clean Water Act goals. 1% of classified stream miles fall into this category. Less than 1% of classified lake acres are considered to be unassessed.

ADDITIONAL INFORMATION ON MISSOURI LAKES

Summary Statistics

Information on beneficial use attainment in significant public lakes is given in Tables 1 and 1A. The acreage of these lakes not fully supporting beneficial uses by major source category are as follows:

Point Sources	43,105 acres
Nonpoint Sources	70,461 acres
Hydromodification	13,730 acres

Background

Missouri's definition of "significant" lakes corresponds to the Department of Natural Resources list of classified lakes and includes any lake that falls into one of the following three categories: (1) small public drinking water reservoirs; (2) large multi-purpose reservoirs; and (3) reservoirs or lakes with important recreational values.

It should be noted that Missouri has only a few naturally occurring lakes, these being primarily depressions or old ox-bows on the Missouri or Mississippi river floodplain. Most significant "lakes" in the state are man-made reservoirs.

Trophic Status

Eutrophication is a natural process that occurs in lakes involving the gradual filling of the lake over time accompanied by increasing aquatic plant growth. This concept also embraces the enrichment of lakes and reservoirs by additions of nitrogen and phosphorus from human activity. This additional nutrient load causes increased aquatic plant growth, predominantly phytoplankton, which causes lake water to become greener and more turbid.

The trophic state of lakes typically refers to the amount of nitrogen and phosphorus entering the lake or the amount of algae or other aquatic plants present in the lake. Oligotrophic lakes are clear with few nutrients and very little aquatic plant growth. Mesotrophic, eutrophic and hypereutrophic refer respectively to lakes with increasing levels of nutrients and aquatic plant growth. Trophic state is an important way to characterize lakes because it relates directly to such factors as lake clarity, which is greater in oligotrophic and mesotrophic lakes, and fish production, which tends to be greater in eutrophic lakes.

Lake studies conducted by the University of Missouri between 1989 and 2003 on trophic status of Missouri lakes follows.

TABLE 8. TROPHIC STATUS OF SELECTED MISSOURI LAKES AND RESERVOIRS

LAKE	COUNTY	LOCATION	YEARS OF RECORD	SECCHI[1]	TP[2]	TN[3]	CHL-A[4]	TROPHIC STATE[5]
GLACIAL PLAINS								
*Allaman Lake	Clinton	24, 56N, 30W	6	1.2	42	682	16	E
Baring C. Club Lake	Knox	26, 63N, 12W	8	1.3	28	959	21	E
Bean Lake	Platte	12/14, 54N, 37W	1	0.1	264	1,658	144	HE
Belcher Branch Lake	Buchanan	8/17, 55N, 34W	3	1.1	36	547	13	E
Bethany Lake #2	Harrison	27, 64N, 28W	10	1.2	35	730	11	E

LAKE	COUNTY	LOCATION	YEARS OF RECORD	SECCHI[1]	TP[2]	TN[3]	CHL-A[4]	TROPHIC STATE[5]
Big Lake	Holt	18/19, 61N, 39W	1	0.2	328	2,508	166	HE
Bilby Ranch Lake	Nodaway	13/24, 64N, 38W	5	1.1	55	1,014	44	E
Blind Pony Lake	Saline	SE18, 49N, 22W	11	0.7	86	1,279	47	E
Bowling Green Lake	Pike	29, 53N, 2W	15	1.8	26	541	9	M
Brookfield Lake	Linn	33, 58N, 19W	13	1.2	24	628	9	M
*Busch W.A. #37	St. Charles	27, 46N, 2E	2	1.1	33	540	8	E
Charity Lake	Atchison	32, 66N, 41W	2	1.8	36	540	16	E
Concordia Lake (Pape)	Lafayette	20, 48N, 24W	10	0.6	84	1,110	27	E
Lake Contrary	Buchanan	26, 57N, 36W	6	0.3	365	3,060	194	HE
Crystal Lake	Ray	32, 53N, 29W	2	0.6	82	918	34	E
*Daniel Boone Lake	Shelby	31/32, 58N, 12W	2	0.2	187	1,424	38	HE
*Dean Lake	Chariton	3, 54N, 21W	1	0.1	382	2,110	5	HE
Deer Ridge Lake	Lewis	18, 62N, 8W	15	0.9	47	793	17	E
Edina Reservoir	Knox	12, 62N, 12W	8	0.7	71	1,228	20	E
Ella Ewing Lake	Lewis	21, 64N, 10W	6	0.6	87	1,410	28	E
*Elmwood Lake	Sullivan	26, 63N, 20W	9	0.8	58	792	20	E
Forest Lake	Adair	14, 62N, 16W	15	1.4	24	411	5	M
Fox Valley Lake	Clark	27, 66N, 8W	5	2.3	18	604	8	M
Green City Lake	Sullivan	NE16, 63N, 18W	5	0.6	85	1,081	33	E
Hamilton Lake	Caldwell	15, 57N, 28W	9	0.8	63	984	13	E
Harrison County Lake	Harrison	17/30, 65N, 28W	5	0.9	53	1,036	40	E
Hazel Creek Lake	Adair	31, 64N, 15W	11	1.4	29	622	8	M
Henry Sever Lake	Knox	14, 60N, 10W	15	0.9	53	1,039	21	E
Higginsville Lake	Lafayette	9, 49N, 25W	15	0.7	98	1,254	22	E
Hunnewell Lake	Shelby	25, 57N, 9W	15	0.9	48	830	24	E
Indian Creek Lake	Livingston	15/27, 59N, 25W	3	1.9	23	630	11	M
Jamesport Comm. Lake	Daviess	20, 60N, 26W	1	0.3	139	2,120	141	HE
*Jo Shelby Lake	Linn	36, 57N, 22W	2	0.9	70	546	37	E
King Lake	Gentry	SW34, 61N, 32W	4	0.2	224	1,530	16	HE
Kings Lake	Lincoln	25,50N, 2E	1	0.3	278	1,573	80	HE
Kraut Run Lake (Busch WA #33)	St. Charles	23, 46N, 2E	15	0.5	98	1,086	58	E
La Belle #2 Lake	Lewis	NE16, 61N, 9W	3	0.8	57	1,422	46	E
Lancaster New Lake	Schuyler	23, 66N, 15W	2	0.8	64	878	29	E
La Plata New Lake	Macon	14, 60N, 14W	2	1.2	26	725	13	M
Lawson City Lake	Ray	31, 54N, 29W	2	0.8	38	975	33	E
Limpp Lake	Gentry	29, 61N, 32W	2	0.3	123	1,995	100	HE
Lincoln Lake	Lincoln	8, 49N, 1E	15	2.1	19	452	6	M
Little Dixie Lake	Callaway	26, 48N, 11W	15	0.6	68	771	18	E
Long Branch Lake	Macon	18, 57N, 14W	15	0.7	52	845	16	E
Macon Lake	Macon	17, 57N, 14W	11	0.8	53	892	29	E
Lake Mahoney (Unionville New)	Putnam	27, 66N, 19W	10	0.6	105	1,253	43	E
Maple Leaf Lake	Lafayette	4, 48N, 26W	6	1.1	42	878	23	E
Marceline Res.	Linn	28, 57N, 18W	10	0.7	107	1,092	45	E
Lake Marie	Mercer	36, 66N, 24W	9	2.7	15	445	4	M
Mark Twain Res.	Ralls	26, 55N, 7W	15	1.1	72	1335	18	E
Maysville Lake (NW)	Dekalb	33, 59N, 31W	10	0.6	202	1,322	50	HE
Memphis #1 Lake	Scotland	14, 65N, 12W	9	0.6	82	1,285	49	E
Milan Lake (New)	Sullivan	35, 63N, 20W	8	1.1	42	688	13	E
Monroe City Lake B	Monroe	30, 56N, 7W	10	0.5	81	1,109	30	E
Mozingo Lake	Nodaway	19, 65N, 34W	5	1.6	27	793	17	E

LAKE	COUNTY	LOCATION	YEARS OF RECORD	SECCHI[1]	TP[2]	TN[3]	CHL-A[4]	TROPHIC STATE[5]
Nehai Tonkayea Lake	Chariton	11, 55N, 18W	9	1.7	19	431	3	M
Nodaway Lake	Nodaway	20, 65N, 35W	5	0.8	42	948	22	E
Lake Paho	Mercer	25, 65N, 25W	10	0.8	48	848	14	E
Pony Express Lake	Dekalb	33, 58N, 31W	10	0.8	69	1,052	32	E
*Prairie Lake	St. Charles	39.708, -90.691	1	0.7	98	790	12	E
*Prairie Slough	Lincoln	2/12, 51N, 2E	1	0.2	231	2,495	72	HE
Ray Co. Lake	Ray	13, 52N, 28W	2	0.4	162	1,960	149	HE
Rocky Fork Lake	Boone	31, 50N, 12W	8	1.9	23	546	7	M
Rocky Hollow Lake (Williams)	Clay	33, 53N, 30W	8	1.4	55	784	21	E
*Rothwell Lake	Randolph	3, 53N, 14W	2	1.3	49	730	32	E
Lake St. Louis	St. Charles	SW26, 47N, 2E	9	0.5	86	1,171	29	E
Lake Ste. Louise	St. Charles	SW27, 47N, 2E	3	1.1	31	513	6	M
Savannah Lake	Andrew	7, 59N, 35W	2	1.2	44	755	22	E
Shelbina Lake	Shelby	20, 57N, 10W	9	0.6	100	1,081	37	E
Smithville Lake	Clay	13, 53N, 33W	15	1.0	33	822	17	E
Spring Lake	Adair	SW20, 61N, 16W	9	1.2	35	533	9	E
Sterling Price Lake	Chariton	17,53N, 17W	7	0.6	108	1545	83	HE
Sugar Creek Lake	Randolph	16, 54N, 14W	9	0.8	56	765	26	E
Sugar Lake	Buchanan	27, 55N, 37W	6	0.2	333	2,524	173	HE
*Swan Pond	Lincoln	39.101, -90.728	1	0.3	345	1,658	126	HE
Thomas Hill Res.	Randolph	24, 55N, 16W	10	0.7	52	792	16	E
Thunderhead Lake	Putnam	15, 66N, 19W	10	0.8	51	971	14	E
Vandalia Lake	Pike	12, 53N, 5W	9	0.7	58	876	20	E
Lake Viking	Daviess	9, 59N, 28W	11	1.0	72	962	38	E
Wakonda Lake	Lewis	NE13, 60N, 6W	6	0.8	95	1,186	51	E
Watkins Mill Lake	Clay	22, 53N, 30W	15	0.9	41	631	18	E
Waukomis Lake	Platte	17, 51N, 33W	10	1.7	25	592	14	E
Weatherby Lake	Platte	15, 51N, 34W	3	2	20	403	5	M
Whiteside Lake	Lincoln	39.174, -91.011	2	2.5	20	630	6	M
Willow Brook Lake	Dekalb	4, 58N, 31W	3	0.6	82	1,280	41	E
Worth Co. Lake	Worth	29/32, 65N, 32W	2	0.6	77	1,435	60	E
OSAGE PLAINS								
Amarugia Highlands Lake	Cass	10, 43N, 32W	6	0.9	57	701	12	E
Atkinson Lake	St. Clair	6, 37N, 28W	15	0.5	74	1,003	36	E
Blue Springs Lake	Jackson	3, 48N, 31W	5	1.0	36	553	16	E
Bushwhacker Lake	Vernon	27, 34N, 32W	3	1.7	28	605	16	E
Butler Lake	Bates	14, 40N, 32W	3	0.7	70	950	36	E
Catclaw Lake	Jackson	14, 47N, 31W	2	0.2	126	862	4	E
Coot Lake	Jackson	22, 47N, 31W	2	0.7	50	856	10	E
Cottontail Lake	Jackson	14, 47N, 31W	2	0.2	140	946	15	E
*Four Rivers CA Lake	Vernon	4, 37N, 31W	1	1.0	34	460	7	M
Gopher Lake	Jackson	23, 47N, 31W	2	0.4	94	776	17	E
Harmony Mission Lake	Bates	15, 38N, 32W	6	1.2	46	828	22	E
Lake Harrisonville	Cass	26, 46N, 31W	7	0.9	50	946	16	E
Hazel Hill Lake	Johnson	28, 47N, 26W	5	0.7	53	1,014	34	E
Holden City Lake	Johnson	7, 45N, 27W	5	0.7	51	1,031	16	E
Jackrabbit Lake	Jackson	15, 47N, 31W	2	0.2	168	783	14	HE

LAKE	COUNTY	LOCATION	YEARS OF RECORD	SECCHI[1]	TP[2]	TN[3]	CHL-A[4]	TROPHIC STATE[5]
Lake Jacomo	Jackson	11, 48N, 31W	8	1.3	34	573	19	E
Lamar Lake	Barton	32, 32N, 30W	9	0.8	79	962	44	E
Lone Jack Lake	Jackson	14, 47N, 30W	2	2.0	26	600	15	M
Longview Lake	Jackson	20, 47N, 32W	8	0.8	38	757	12	E
Lotawana Lake	Jackson	29, 48N, 30W	8	1.4	31	672	16	E
Montrose Lake	Henry	33, 41N, 27W	8	0.2	189	1,292	63	HE
Nell Lake	Jackson	15, 47N, 31W	2	0.6	68	834	10	E
North Lake	Cass	28, 45N, 31W	15	0.7	96	1,006	43	E
Odessa Lake	Lafayette	15, 48N, 28W	1	2.0	26	770	19	E
Prairie Lee Lake	Jackson	27, 48N, 31W	8	0.8	55	915	25	E
Raintree Lake	Cass	6, 46N, 31W	15	0.6	62	967	16	E
Spring Fork Lake	Pettis	21, 44N, 21W	9	0.6	146	1,124	47	HE
Lake Tapawingo	Jackson	34, 49N, 31W	8	1.3	34	842	32	E
*Tebo Lake (Westmoreland)	Pettis	12, 44N, 22W	6	2.8	18	609	4	M
Winnebago Lake	Cass	9, 46N, 31W	8	0.9	51	838	18	E
OZARK BORDER								
*Bella Vista Lake	Cape Girardeau	2/11, 32N, 13E	6	1.4	23	552	12	M
Binder Lake	Cole	36, 45N, 13W	15	1.0	56	768	24	E
*Boutin Lake	Cape Girardeau	15, 32N, 14E	6	1.5	23	558	8	M
Creve Couer Lake	St. Louis	20, 46N, 5E	7	0.3	154	1,053	57	HE
*D.C. Rogers Lake	Howard	3, 50N, 16W	9	1.3	31	533	7	M
Fayette Lake #2	Howard	4, 50N, 16W	6	0.9	52	906	24	E
Lake Forest (Lake Ann)	St. Genevieve	36, 38N, 7E	10	1.3	43	649	22	E
Lake Girardeau	Cape Girardeau	9, 30N, 11E	6	0.7	73	1,011	50	E
Glover Spring Lake	Callaway	13, 47N, 9W	7	1.2	67	863	22	E
Goose Creek Lake	St. Francois	26, 38N, 6E	10	2.1	15	389	5	M
Manito Lake	Moniteau	8/9, 44N, 17W	5	0.6	96	970	14	E
Lake Northwoods	Gasconade	33, 43N, 5W	12	1.2	24	448	5	M
Perry Co. Lake	Perry	22, 35N, 10E	6	0.8	77	1,053	45	E
Pinewoods Lake	Carter	7,26N, 3E	4	1.3	40	788	22	E
Pinnacle Lake	Montgomery	24, 47N, 5W	5	2.6	24	463	5	M
Timberline Lake	St. Francois	23, 38N, 4E	10	4.2	9	299	2	O
Lake Tishomingo	Jefferson	5, 41N, 4E	10	2	22	495	6	M
*Tri-City Comm Lake	Boone	24, 51N, 12W	9	0.7	58	876	20	E
Tywappity Lake	Scott	8, 29N, 13E	6	0.9	50	1,005	36	E
Wanda Lee Lake	St. Genevieve	2, 37N, 7E	10	1.3	56	577	26	E
Lake Wappapello	Wayne	3, 26N, 3E	15	1.0	37	505	23	E
Lake Wauwanoka	Jefferson	1, 40N, 4E	10	2.8	14	613	3	M
OZARK HIGHLANDS								
Austin Lake	Texas	30, 29N, 11W	8	1.7	21	503	7	M
*Bismarck Lake	St. Francois	19, 35N, 4E	5	2.0	21	373	7	M
Bull Shoals Lake	Taney	21-23N, 15-20W	7	2.1	19	355	8	M
*Lake Capri	St. Francois	30, 37N, 4E	15	4.6	7	284	1	O
*Lake Carmel	St. Francois	18, 37N, 4E	11	2.8	10	316	3	O
Clearwater Lake	Reynolds	6, 28N, 3E	15	1.9	15	227	5	M
Council Bluff Lake	Iron	23, 35N, 1E	15	3.1	8	239	2	O
Crane Lake	Iron	33, 32N, 4E	7	1.2	14	252	4	M
Fellows Lake	Greene	22, 30N, 21W	15	2.7	14	364	5	M
Fourche Lake	Ripley	22, 23N, 1W	10	3.5	10	246	3	O

LAKE	COUNTY	LOCATION	YEARS OF RECORD	SECCHI[1]	TP[2]	TN[3]	CHL-A[4]	TROPHIC STATE[5]
Fredericktown City Lake	Madison	6, 33N, 7E	8	0.7	65	752	33	E
H.S. Truman Lake	Benton	7, 40N, 23W	15	1.2	42	865	16	E
Indian Hills Lake	Crawford	23, 39N, 5W	12	1.0	36	640	18	E
Lake Killarney	Iron	1, 33N, 4E	6	0.8	66	631	29	E
*Lafitte Lake	St. Francois	28, 37N, 4E	1	4.4	6	320	2	O
*Little Prairie Lake	Phelps	21, 38N, 7W	15	0.9	31	504	9	M
Loggers Lake	Dent	10, 31N, 3W	6	3.1	10	237	4	M
Lower Taum Sauk	Reynolds	33, 33N, 2E	8	2.1	13	201	4	M
Macs Lake (Ziske)	Dent	NE17, 34N, 5W	6	1.4	25	622	23	E
*Lake Marseilles	St. Francois	29, 37N, 4E	8	3.7	11	351	2	O
McDaniel Lake	Greene	26, 30N, 22W	14	1.4	33	486	18	E
*Miller Lake	Carter	1, 27N, 1E	8	1.5	19	469	6	M
Monsanto Lake (St. Joe State Park)	St. Francois	20, 36N, 5E	8	2.3	10	372	2	O
Noblett Lake	Douglas	25, 26N, 11W	6	2.6	18	255	5	M
Norfork Lake	Ozark	21N, 12W	6	1.7	23	631	6	M
Lake of the Ozarks (Lower)	Miller	19, 40N, 15W	13	1.9	28	617	15	E
Peaceful Valley	Gasconade	25, 42N, 6W	11	1.4	37	850	30	E
Pomme de Terre Lake	Hickory	2, 36N, 22W	15	1.7	29	574	16	E
*Pomona Lake	Howell	26, 26N, 9W	1	--	50	605	10	E
Ripley Co. Lake	Ripley	10, 23N, 1E	6	1.5	32	787	26	E
Roby Lake	Texas	3, 32N, 11W	8	2.1	18	431	5	M
Shawnee Lake (Turner)	Dent	NW17, 34N, 5W	6	1.7	30	610	25	E
Lake Shayne	Washington	25, 37N, 3E	14	2.9	7	275	1	O
Sims Valley Lake	Texas	17, 27N, 8W	8	1.1	27	504	13	M
Lake Springfield	Greene	20, 61N, 16W	7	1.0	60	1,016	19	E
Stockton Lake	Cedar	15, 34N, 26W	15	2.8	13	429	6	M
Sunnen Lake	Washington	4, 37N, 1E	12	2.6	13	286	4	M
Table Rock Lake	Stone	22, 22N, 22W	15	3.3	11	384	5	M
Lake Taneycomo	Taney	8, 23N, 20W	6	3.5	23	803	3	M
SOUTHEASTERN LOWLANDS								
Big Oak Tree S.P. Lake	Mississippi	14, 23N, 16E	2	0.6	44	530	12	E
Upper Big Lake	Mississippi	25, 27N, 16E	2	0.3	338	2,050	181	HE

[1]Secchi depth (m)
[2]Total Phosphorus (σg/L)
[3]Total Nitrogen (σg/L)
[4]Chlorophyll A (σg/L)
[5]Trophic State: O=Oligotrophic, M=Mesotrophic, E=Eutrophic, HE=Hypereutrophic

*Unclassified Lake

Trophic status correlates strongly with physiographic regions of the state. In agricultural northern and western Missouri, most lakes of known trophic state are eutrophic, while in the Ozarks and Ozark border regions, trophic states are more equally divided between eutrophic and either mesotrophic or oligotrophic lakes. Most known hypereutrophic lakes are in glaciated northern Missouri, while nearly all oligotrophic lakes are in unglaciated, highly weathered Ozark terrain.

The method presently used by the state to determine trophic status was derived from the work by Wetzel, R.G., 1975; "Limnology," Table 14-11; and from Vollenweider, R.A. and J.J. Kerekes, 1980. EPA440/5-81-010; "Restoration of Lakes and Inland Waters." The criteria are shown in the table below.

TABLE 9. DEFINITION OF TROPHIC CLASSIFICATION

Trophic Class	Chlorophyll-A (ug/l)	Total phosphorus (ug/l)
Oligotrophic	<3	<10
Mesotrophic	3-10	10-30
Eutrophic	11-56	31-100
Hypereutrophic	>56	>100

STATUS OF WETLANDS

Originally about 4.8 million acres (10.7 percent of the land surface of the state) in Missouri were wetlands. By 1992 it was estimated that less than 480,000 acres remained. Several state and federal programs have recognized the need to preserve and enhance our remaining wetlands.

From 1998 to 2003, the Missouri Department of Conservation has purchased 23,186 acres of wetlands, and restored an additional 32,662 acres.

In 1994, the U.S. Fish and Wildlife Service began the process of acquiring land from willing sellers in the Missouri River floodplain for a national wildlife refuge called Big Muddy. The project authorizes the purchase of up to 60,000 acres in 25 to 30 units between Kansas City and St. Louis. The refuge currently consists of 10,400 acres of land in six units, four of which are publicly accessible. These units are at Overton Bottoms, Jameson Island, Lisbon Bottoms, and Baltimore Bend. The refuge focuses on restoring several kinds of riverine and floodplain habitat, and allowing lands to interact naturally with the river and act as seasonal wetlands.

The Natural Resources Conservation Service Wetlands Reserve Program begun in 1992, purchases easements of wetlands and provides funds for restoration of those wetlands. There are presently 699 easements covering 99,354 acres in place, with an additional 32 easements, covering 9,630 acres, in progress.

Two websites providing information on Missouri's wetlands and efforts to restore wetlands are given below:

http://www.conservation.state.mo.us/landown/wetland/wetmng

http://www.nrcs.usda.gov/programs/wrp/states/mo.html

CHAPTER 4. GROUND WATER ASSESSMENT

BACKGROUND

Somewhat less than half of the people in Missouri rely on ground water as the source of their drinking water. Ground water is the major source of drinking water in the Ozarks and the Southeast Lowlands for both public and private supplies. The cities of St. Joseph, Independence, Columbia and St. Charles use ground water adjacent to the Missouri River. In the plains region of the state, many small communities are able to obtain adequate water from shallow alluvial wells near rivers or large creeks, and many individual households still rely on the upland shallow aquifer even though it yields only very small amounts of water.

In the Ozarks, ground water yields are usually large and of excellent quality, as witnessed by the fact that unlike cities in other areas of the state, many municipalities pump ground water directly into their water supplies without treatment. However, the geologic character of the Ozarks that supplies it with such an abundance of ground water, namely its ability to funnel large amounts of rainfall and surface runoff to the ground water system, can present problems for ground water quality. This is because much surface water flows directly to ground water through cracks, fractures or solution cavities in the bedrock, with little or no filtration. Contaminants from leaking septic tanks or storage tanks, or surface waters affected by domestic wastewater, animal feedlots and other pollution sources can move directly into ground water through these cavities in the bedrock.

Like in the Ozarks, ground water in the southeast lowlands is abundant and of good quality. Unlike the Ozarks, contaminants are filtered by thick deposits of sand, silt and clay as they move through the ground water system. Thus, while shallow ground water wells are subject to the same problems with elevated levels of nitrate or bacteria as are found locally in the Ozark aquifer, and can also have low levels of pesticides, deep wells are generally unaffected by contaminants.

Shallow ground water in the plains of northern and western Missouri tends to be somewhat more mineralized and to have taste and odor problems due to high levels of iron and manganese. Like shallow wells in the southeast lowlands, wells in this part of the state can be affected by nitrates, bacteria or pesticides.

In urban areas, alluvial aquifers of large rivers such as the Missouri and the Meramec that serve water supplies have occasionally been locally contaminated by spills or improper disposal of industrial or commercial chemicals.

WELL CONSTRUCTION AND GROUND WATER QUALITY

Well water quality is greatly influenced by well construction. Public drinking water wells and many private wells are deep, and properly cased and grouted. These wells rarely become contaminated. However, many private wells are shallow or not properly cased. These wells can be easily contaminated by septic tanks, feedlots or chemical mixing sites near the well. Studies in Missouri have shown that two-thirds of wells contaminated by pesticides are less than 35 feet deep. The three most common problems in private wells are bacteria, nitrate and pesticides. Groundwater studies in Missouri indicate that about 30 percent of private wells occasionally exceed drinking water standards for bacteria, 30 percent for nitrate and about five percent for pesticides. State regulations include standards for construction and wellhead protection for all new wells.

MAJOR POTABLE AQUIFERS IN MISSOURI

The location of the major aquifers providing drinkable water in Missouri are shown below. The unconfined aquifers are those under water table conditions (the pressure at the water table is the atmospheric pressure). These unconfined aquifers tend to yield greater amounts of water, but are also more easily contaminated by activities occurring at the land surface. In confined aquifers, the upper level of the saturated zone is restricted so that the pressure level is greater than exists at that level of saturation. Confined aquifers are generally recharged more slowly than unconfined aquifers but are better protected from surface contaminants.

Glacial Till Aquifer

This aquifer covers most of Missouri north of the Missouri River. Glacial till is an unsorted mixture of clay, sand and gravel, with occasional boulders and lenses of sand or gravel. Loess, fine wind-blown silt deposits of four to eight feet in depth, cover the till on the uplands. In places, the till is underlain by sorted deposits of sand or gravel. Although this aquifer is unconfined, surface water infiltrates very slowly, and ground water yields are very small. In scattered areas the till has buried old river channels that remain as large sand or gravel deposits that contain much more ground water than the till.

Some households still rely on this aquifer for drinking water, but it is generally inadequate as a source for municipal water supply.

Alluvial Aquifer

Alluvial aquifers are the unconfined aquifers on floodplains of rivers and are of Quaternary age. In Missouri, the largest of these aquifers lie along the Missouri and Mississippi rivers, reaching their widest extent in the southeast lowlands where they extend for as much as 50 miles west of the Mississippi River. Many small communities north of the Missouri River use the alluvial aquifers of nearby streams for their drinking water supply, and the Missouri River alluvium supplies the cities of St. Joseph, Independence and Columbia and sections of St. Charles County. In the southeast lowlands, most private water supplies and about 45 percent of people served by public water supplies use water from the alluvial aquifer. Agricultural irrigation consumes about five times more water in this area of Missouri than does domestic water use. All agricultural irrigation water is drawn from the alluvial aquifer.

Wilcox-McNairy Aquifer

These two aquifers lie beneath much of the alluvial aquifer of the southeast lowlands. They are in unconsolidated or loosely consolidated deposits of marine sands and clays of Tertiary and Cretaceous age. Except where the McNairy aquifer outcrops in the Benton Hills and along Crowley's Ridge, these aquifers are confined. They yield abundant amounts of good quality water, and they provide the water for 55 percent of people served by public supplies. In the southeastern part of this region, the deeper of these aquifers, the McNairy, becomes too mineralized to be used for drinking water supply. These two aquifers appear to be unaffected by contaminants of human origin.

Ozark-St. Francis Aquifer

This aquifer covers most of the southern and central two-thirds of Missouri. It is composed of dolomites and sandstones of Ordovician and Cambrian age. Most of the aquifer is unconfined. This aquifer is used for almost all public and private drinking water supplies in this area of Missouri. Exceptions would include supplies in the St. Francis Mountains, such as Fredericktown and Ironton, where the aquifer has been lost due to geologic uplift and erosion, and in Springfield, where demand is so heavy that ground waters are supplemented with water from three large reservoirs and the James River.

Yields and water quality are typically very good, but in many areas, the bedrock is highly weathered, contains many solution cavities, and can transmit contaminated surface waters into the ground water rapidly with little or no filtration. Where the confined portion of the aquifer is overlain only by the Mississippian limestones of the Springfield aquifer, the confined Ozark aquifer continues westward for 80 miles or more as a potable water supply, serving the communities of Pittsburg, Kansas and Miami, Oklahoma. However, where it is also overlain by less permeable Pennsylvanian bedrock, the confined Ozark becomes too mineralized for drinking within 20 to 40 miles.

The unconfined Ozark-St. Francis aquifer is susceptible to contamination from surface sources. Increasing urbanization and increasing numbers of livestock are threats to the integrity of portions of this valuable aquifer.

Springfield Aquifer

This aquifer covers a large portion of southwestern Missouri. It is composed of Mississippian limestones that are, particularly in the eastern portion of the aquifer, highly weathered. The aquifer is unconfined and surface water in many areas is readily transmitted to ground water. Urbanization and livestock production affect this aquifer. Elevated nitrates and bacterial contamination are common problems in ground waters of the Springfield aquifer.

GROUNDWATER QUALITY SUMMARY TABLES

Table 10 lists the major sources of ground water contamination in Missouri, major contaminants, and reasons why these sources are the most important. Table 11 summarizes ground water quality problems at hazardous waste sites. Tables 12 and 13 provide information on levels of nitrate, pesticides and other toxic organics in public drinking water wells and Table 14 gives the present status of Missouri's ground water protection strategy.

TABLE 10. MAJOR SOURCES OF GROUND WATER CONTAMINATION

Contaminant Source	10 Highest Priority Sources (X) [1]	Factors Considered in Selecting a Contaminant Source[2]	Contaminants [3]
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications	X	A,C,D,E	E
Irrigation practices			
Pesticide applications	X	A,B,C,D,E	B
Storage and Treatment Activities			
Land application	X	A,D,E	J,K,L,E
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	X	A,B,C,D,E	D
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills			
Septic systems	X	A,D,E	J,K,L,E
Shallow injection wells			

Other			
Hazardous waste generators			
Hazardous waste sites	X	A,B,C,D	B,C,H,I
Industrial facilities	X	A,B,C,E	E,Ammonia, PCP, Dioxin
Material transfer operations			
Mining and mine drainage	X	A,E	H
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion	X	C	G
Spills	X	A,B,C,E	B,C,D,Ammonia
Transportation of materials			
Urban runoff			
Other sources (please specify)			
Other sources (please specify)			

(1) Not in Priority Order

(2) Key: Factors Considered in Selecting Contaminant Source.

A. Human health or environmental toxicity risk
B. Size of population at risk
C. Location of sources relative to drinking water sources
D. Number and/or size of contaminant sources
E. Hydrogeologic sensitivity

(3) Key: Contaminants

A. Inorganic Pesticides
B. Organic Pesticides
C. Halogenated Solvents
D. Petroleum compounds
E. Nitrate
F. Fluoride
G. Salinity/brine
H. Metals
I. Radionuclides
J. Bacteria
K. Protozoa
L. Viruses

TABLE 11. GROUND WATER CONTAMINATION SUMMARY

Hydrogeologic Setting All Aquifers
Spatial Description (optional)
Map Available (optional)
Data Reporting Period 2002-2003

Source Type	Number of sites	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contamination	Contaminants *	Number of site investigations (optional)	Number of sites that have been stabilized or have had the source removed (optional)	Number of sites with corrective action plans (optional)	Number of sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL	27	27	22	1	27	12	--	7	6
CERCLIS (non-NPL)	460	144	33	1	33	64	--	26	64
DOD/DOE	104	23	20	2	80	8	11	11	38
LUST	3,749	396	120	3	3,098	401	--	1,239	316
RCRA Corrective Action	101	78	57	4	71	31	18	23	16
Underground Injection									
State Sites	121	121	102	5	119	12	40	36	13
Nonpoint Sources[5]									
Other (specify)									

NPL - National Priority List , DOE- Department of Energy ; DOD- Department of Defense; CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System; LUST - Leaking Underground Storage Tanks; RCRA - Resource Conservation and Recovery Act.

* Contaminants

1 - VOAs, SVOAs, Solvents, PCBs, Dioxin, PAHs, Herbicides, Pesticides, Metals, Explosives ;
2 - VOA, PCB, Pesticides, Dioxin, Metals, Radionuclides, SVOCs, etc.; 3 - BTEX, TPH, MTBE, PAH, Metals, SVOA;
4 - Creosote, penta, Organic Solvents, Petroleum, Asbestos, Metals, Chlorinated Solvents;
5 - Chlorinated Solvents, TPH, BTEX, PAHs, Metals, Pentachlorophenol, pesticides

TABLE 12. AQUIFER MONITORING DATA

Hydrogeologic Setting: Confined Ozark Aquifer
Spatial Description (optional): Western Ozarks and Osage Plains
Map Available (optional):
Data Reporting Period: September 2000 – September 2003

WILCOX/MCNAIRY AQUIFER SITES	NO_3	SOCs	VOCs	Notes (Contaminant Levels and Detects without MCLs)
Anderson	ND	ND	ND	
Arcola	**<5 mg/l**	ND	ND	0.05 mg/L NO_2+NO_3
Asbury	ND	ND	ND	
Ash Grove	ND	ND	ND	
Aurora/Verona	**<5 mg/l**	ND	ND	0.09 mg/L NO_2+NO_3
Barton/Dade/Cedar/Jasper Cos. #1	ND	ND	ND	
Billings	ND	ND	ND	
Branson West	ND	ND	ND	
Butterfield	ND	ND	ND	
Carterville	ND	ND	ND	
Christian Co. #1	ND	ND	ND	
Christian Co. #2	**<5 mg/l**	ND	ND	Well #1: 0.10 mg/L NO_2+NO_3; Well #2: 0.12 mg/L NO_2+NO_3
Clever	ND	ND	ND	
Crane	ND	ND	ND	
Dadeville	ND	ND	ND	
Diggins	ND	ND	ND	
El Dorado Springs	ND	ND	ND	
Everton	**<5 mg/l**	ND	ND	0.19 mg/L NO_2+NO_3
Exeter	ND	ND	ND	
Fair Play	**<5 mg/l**	ND	ND	0.11 mg/L NO_2+NO_3
Fairview	ND	ND	ND	
Fordland	**<5 mg/l**	ND	ND	Well #1: 0.42 mg/L NO_2+NO_3; Well #2: 0.57 mg/L NO_2+NO_3
Golden City	ND	ND	ND	
Greene Co. #1	ND	ND	ND	
Greene Co. #6	**<5 mg/l**	ND	ND	0.09 mg/L NO_2+NO_3
Greenfield	ND	ND	ND	
Houstonia	ND	ND	ND	
Hughesville	**<5 mg/l**	ND	ND	0.36 mg/L NO_2+NO_3
Hurley	ND	ND	ND	
Ionia	ND	ND	ND	
Jasper	ND	ND	ND	
Jerico Springs	ND	ND	ND	

SOC = synthetic organic compound VOC = volatile organic compound NO_3 = nitrate MCL = maximum contaminant level ND = not detected

TABLE 12. AQUIFER MONITORING DATA

Hydrogeologic Setting: Confined Ozark Aquifer
Spatial Description (optional): Western Ozarks and Osage Plains
Map Available (optional):
Data Reporting Period: September 2000 – September 2003

ALLUVIAL AQUIFER SITES	NO_3	SOCs	VOCs	Notes (Contaminant Levels and Detects without MCLs)
Johnson Co. #2	ND	ND	ND	
Knob Noster	ND	ND	ND	
Lanagan	ND	ND	ND	
Leeton	ND	ND	ND	
Liberal	ND	ND	ND	
McDonald Co. #1	ND	ND	ND	
McDonald Co. #2	ND	ND	ND	
Miller	**<5 mg/l**	ND	ND	2.37 mg/L NO_2+NO_3
MoArk Water Co.	**<5 mg/l**	ND	ND	Well #1: 0.12 mg/L NO_2+NO_3; Well #2: 0.12 mg/L NO_2+NO_3
Morrisville	ND	ND	ND	
Newton Co. #1	ND	ND	ND	
Nixa	**<5 mg/l**	ND	ND	Well #1: 0.11 mg/L NO_2+NO_3
Noel	ND	ND	ND	
Ozark	**<5 mg/l**	ND	ND	Well #6: 0.10 mg/L NO_2+NO_3; Well #7: 0.57 mg/L NO_2+NO_3
Pierce City	ND	ND	ND	
Pineville	ND	ND	ND	
Purdy	ND	ND	ND	
Reeds Spring	**<5 mg/l**	ND	ND	0.31 mg/L NO_2+NO_3
Republic	ND	ND	ND	
Rogersville	**<5 mg/l**	ND	ND	0.09 mg/L NO_2+NO_3
Sarcoxie	ND	ND	ND	
Schell City	ND	ND	ND	
Seligman	**<5 mg/l**	ND	ND	0.1 mg/L NO_2+NO_3
Seymour	**<5 mg/l**	ND	ND	North well: 0.18 mg/L NO_2+NO_3; South well: 0.14 mg/L NO_2+NO_3
South Greenfield	ND	ND	ND	
Southwest City	**<5 mg/l**	ND	ND	Well #2: 0.67 mg/L NO_2+NO_3
Southwest RWD #1	ND	ND	ND	
Sparta	**<5 mg/l**	ND	ND	Well #1: 0.34 mg/L NO_2+NO_3; Well #2: 0.28 mg/L NO_2+NO_3
Stella	ND	ND	ND	
Stockton	ND	ND	ND	
Stone Co. #1	**<5 mg/l**	ND	ND	Well #2: 0.07 mg/L NO_2+NO_3
Strafford	ND	ND	ND	
Walnut Grove	ND	ND	ND	
Warrensburg (Missouri American)	ND	ND	ND	
Washburn	ND	ND	ND	
Wheaton	ND	ND	ND	
Willard	ND	ND	ND	

SOC = synthetic organic compound VOC = volatile organic compound NO_3 = nitrate MCL = maximum contaminant level ND = not detected

SUMMARY OF GROUND WATER PROTECTION PROGRAMS

TABLE 13. GROUND WATER PROTECTION STRATEGY

Program or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III Program	X		MDPS/SEMA
Ambient ground water monitoring system		NA	
Ground water monitoring at sanitary landfills	X	Fully established	DNR
Aquifer vulnerability assessment	X		DNR
Aquifer mapping		NA	
Aquifer characterization		NA	
Comprehensive data management system		NA	
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)		Under development	DNR
Ground water discharge permits	X	Fully established	DNR
Ground water best management practices (BMPs)	X	Continuing effort	DNR
Ground water legislation	X		DNR
Ground water classification		NA	
Ground water quality standards	X	Fully established	DNR
Interagency coordination for ground water protection initiatives	X	Fully established	DNR
Nonpoint source controls		Continuing effort	DNR
Pesticide State Management Plan		Pending	MDA
Pollution Prevention Program	X	Continuing effort	DNR
Resource Conservation and Recovery Act (RCRA) Primacy	X	Fully established	DNR
State Superfund	X	Fully established	DNR
State RCRA Program incorporating more stringent requirements than RCRA Primacy	X	Fully established	DNR
State septic system regulations	X	Fully established	MDHSS
Underground storage tank installation requirements	X	Fully established	DNR
Underground Storage Tank Remediation Fund	X	Fully established	DNR
Underground Storage Tank Permit Program		NA	
Underground Injection Control Program	X	Fully established	DNR
Vulnerability assessment for drinking water/wellhead protection	X	Fully established	DNR
Well abandonment regulations	X	Fully established	DNR
Wellhead Protection Program (EPA-approved)	X	Fully established	DNR
Well installation regulations	X	Fully established	DNR

MDPS/SEMA = Missouri Department of Public Safety, State Emergency Management Agency
MDA = Missouri Department of Agriculture
MDHSS = Missouri Department of Health & Senior Services

Notes:

Active SARA Title III Program: Administered by Department of Public Safety, State Emergency Management Agency.

Ambient ground water monitoring system: There is no system per se. The state has participated in several opportunities to monitor ambient ground water, such as impact analyses following the floods of 1993.

Aquifer vulnerability assessment: These are conducted by the department's Geological Survey & Resource Assessment Division on a county-by-county basis as funding allows.

Aquifer mapping and characterization: No present systematic activity, although these activities may be conducted in concert with hazardous substance release investigations.

Comprehensive data management system: None.

EPA-endorsed Core Comprehensive State Ground Water Protection Program: No formal program established.

Ground water discharge permits: Underground Injection Control permits issued jointly by the department's Geological Survey & Resource Assessment Division and Water Pollution Control Program.

Ground Water Best Management Practices: Some BMPs are established as part of the Nonpoint Source Management Plan.

Ground water legislation: The Cave Resources Act and Clean Water Law deal directly with ground water. Other laws, such as the Dead Animal Disposal Statute, prescribe protections for ground water. There is no comprehensive ground water protection statute per se.

Ground water classification: None, although a utilities group proposed a classification system.

Ground water quality standards: Established as part of state water quality standards.

Interagency coordination for ground water protection initiatives: Opportunities for monthly coordination are provided through the Water Quality Coordinating Committee.

Nonpoint source controls: The nonpoint source management program provides guidance for voluntary controls.

Pesticide State Management Program: A draft generic pesticides and water quality management plan has been prepared by the Department of Agriculture in conjunction with the Department of Natural Resources. The plan will address both ground water and surface water, and has been submitted to EPA for approval.

Pollution Prevention Program: Some activities carried out by staff in the department's Outreach and Assistance Center.

Resource Conservation and Recovery Act (RCRA) Primacy: Administered by the department's Hazardous Waste Program.

State Superfund: Administered by the department's Hazardous Waste Program. This provides for a state registry of confirmed abandoned hazardous waste disposal sites.

State RCRA Program: Incorporating more stringent requirements than RCRA Primacy: Administered by the department's Hazardous Waste Program.

State septic system regulations: Administered by the Department of Health & Senior Services.

Underground storage tank installation requirements: Administered by the department's Hazardous Waste Program.

Underground Storage Tank Remediation Fund: The UST remediation fund was created by statute in 1995. The UST insurance fund was amended by statute in 1996 by creating a board of trustees and broadening eligibility.

Underground Storage Tank Permit Program: Tanks are required to be registered but not permitted.

Underground Injection Control Program: Administered by the department's Geological Survey & Resource Assessment Division.

Vulnerability assessment for drinking water/wellhead protection: Administered by the department's Water Protection Program.

Well abandonment regulations: Administered by the department's Geological Survey & Resource Assessment Division.

Wellhead Protection Program (EPA-approved): Administered by the department's Water Protection Program.

Well installation regulations: Administered by the department's Geological Survey & Resource Assessment Division.

For more information, call the Department of Natural Resources at (573) 751-1300.

MAPS OF IMPAIRED WATERS

The maps that follow show streams and lakes impaired by point sources and discrete (localized) nonpoint sources. These maps do not show nonpoint source problems such as stream channelization, aquatic habitat degradation due to agricultural or urban storm water runoff, or wide-scale land use changes such as conversion of rural to urban lands.

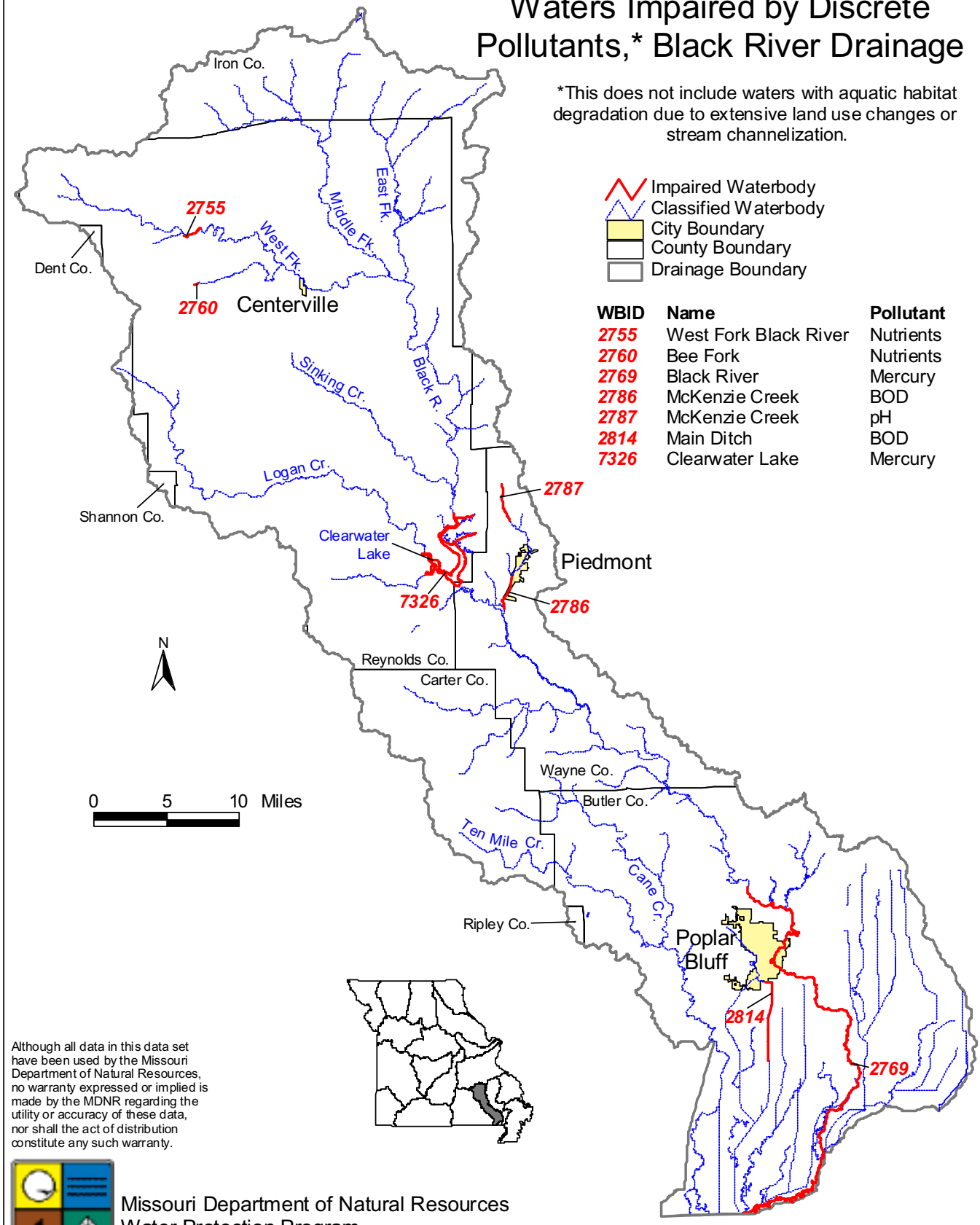
Impaired waters are shown in red. An accompanying table lists the name of the impaired stream or lake and the pollutant causing the water quality impairment.

Terms and abbreviations used in these tables are as follows:

Ammonia (NH3N)- a form of nitrogen that can be toxic to fish and other aquatic animals.
Atrazine- common agricultural herbicide used on corn and grain sorghum.
BOD (Organic Enrichment)- Biochemical Oxygen Demand, an indicator of the amount of organic matter in the water.
Cadmium- a heavy metal associated with mining areas that is harmful to aquatic life.
Chlordane- a pesticide with agricultural and urban uses. Banned for all uses in 1988.
Chloride- the ionic form of chlorine, generally indicating saltiness and harmful to aquatic life.
Chlorine- common disinfectant used by many wastewater treatment plants and highly toxic to aquatic life.
Color- some industrial process emit effluent containing dissolved substances that impart unsightly color to receiving waters.
Fecal Coliform- a type of bacteria that indicates the presence of fecal material from humans or other mammals.
Lead- a heavy metal that is toxic to aquatic life. It can contaminate sediments near lead mining and certain industrial discharges. Eating lead-contaminated fish may cause human health problems.
Low Dissolved Oxygen- inadequate levels of oxygen in the water can cause disease or death in fish and most other aquatic animals.
Manganese- elevated levels in water can cause taste, odor or laundry staining problems in drinking water supplies.
Mercury- a heavy metal that does not persist in water, but accumulates in fish tissue and is potentially toxic to humans who eat fish with high levels over a long period of time. It is generally believed to enter the water from the air, after being released by coal-firing power plants.
NFR- Nonfilterable Residue, an indicator of the amount of suspended material in the water.
Nickel- a heavy metal that is toxic to aquatic life. A rare water contaminant in Missouri associated with one abandoned copper-nickel-cobalt mine near Fredericktown, Mo.
Nutrients- Nitrogen and Phosphorus, the two elements most likely to stimulate excessive algae growth in streams and lakes.
pH- the acidity or alkalinity of the water. Most pH problems in Missouri waters are due to acidity (low pH).
Sediment- particulate matter deposited on the bottom of a stream or lake. Large sediment deposits can be harmful to aquatic life.
Sulfate-a common dissolved substance in water. Excessive amounts can occur from coal mining areas or some industrial discharges and can be toxic to aquatic life.
Temperature- some industrial processes result in the release of effluent that is too warm for aquatic life.
Unknown- Aquatic life has been found to be impaired, but the pollutant responsible has not been identified.
Zinc- a heavy metal that is toxic to aquatic life. It can contaminate water and sediments near zinc mining and certain industrial discharges.

Waters Impaired by Discrete Pollutants,* Black River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
2755	West Fork Black River	Nutrients
2760	Bee Fork	Nutrients
2769	Black River	Mercury
2786	McKenzie Creek	BOD
2787	McKenzie Creek	pH
2814	Main Ditch	BOD
7326	Clearwater Lake	Mercury

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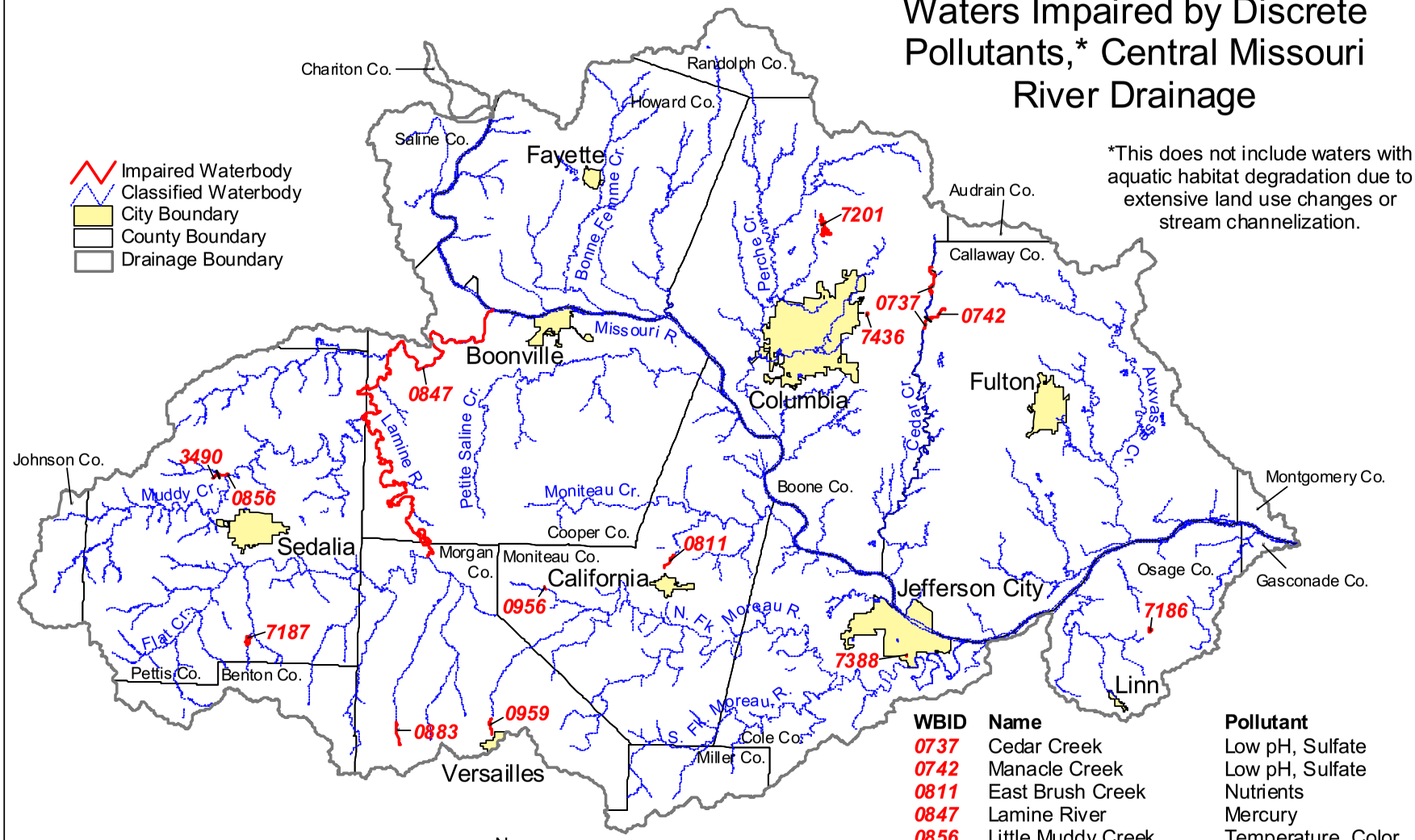
Waters Impaired by Discrete Pollutants,* Central Missouri River Drainage



*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
0737	Cedar Creek	Low pH, Sulfate
0742	Manacle Creek	Low pH, Sulfate
0811	East Brush Creek	Nutrients
0847	Lamine River	Mercury
0856	Little Muddy Creek	Temperature, Color
0883	Gabriel Creek	Nutrients, Ammonia
0956	Trib. Willow Fork	Ammonia
0959	Straight Fork	Sulfate, NFR
3490	Trib. Little Muddy Creek	Temperature, Color
7186	Ben Branch Lake	Mercury
7187	Spring Fork Lake	Nutrients
7201	Finger Lakes	Fecal Coliform
7388	Hough Park Lake	Mercury
7436	Lake of the Woods	Mercury

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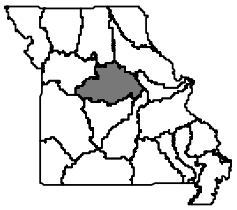

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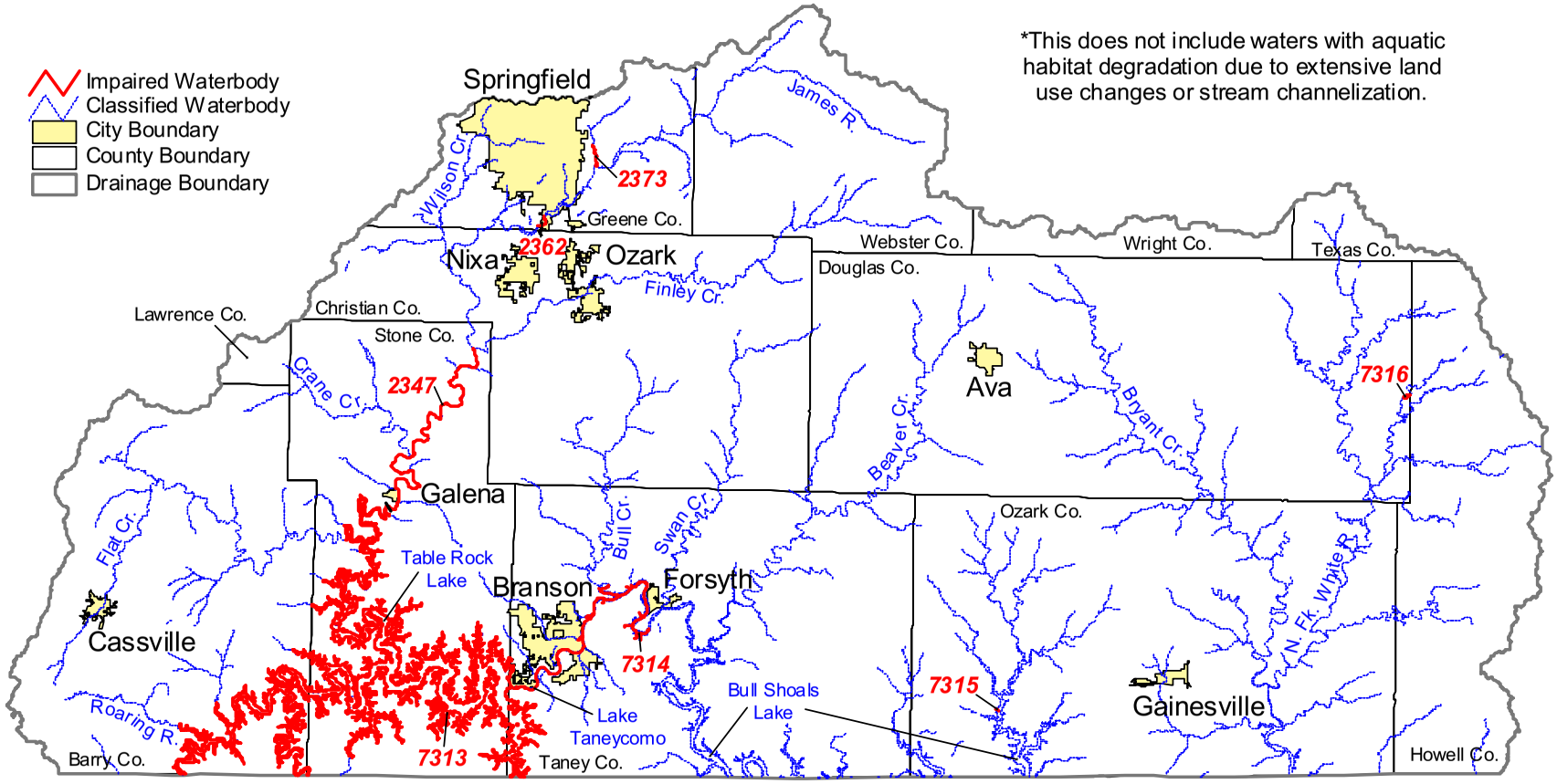
Waters Impaired by Discrete Pollutants,* White River Drainage



WBID	Name	Pollutant
2347	James River	Mercury
2362	James River	Temperature
2373	Pearson Creek	Unknown
7313	Table Rock Lake	Nutrients
7314	Lake Taneycomo	Low Dissolved Oxygen
7315	Bull Shoals Lake	Fecal Coliform
7316	Noblett Lake	Mercury

N

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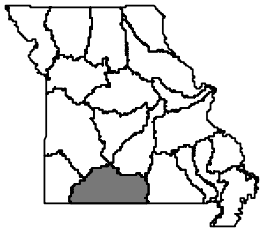

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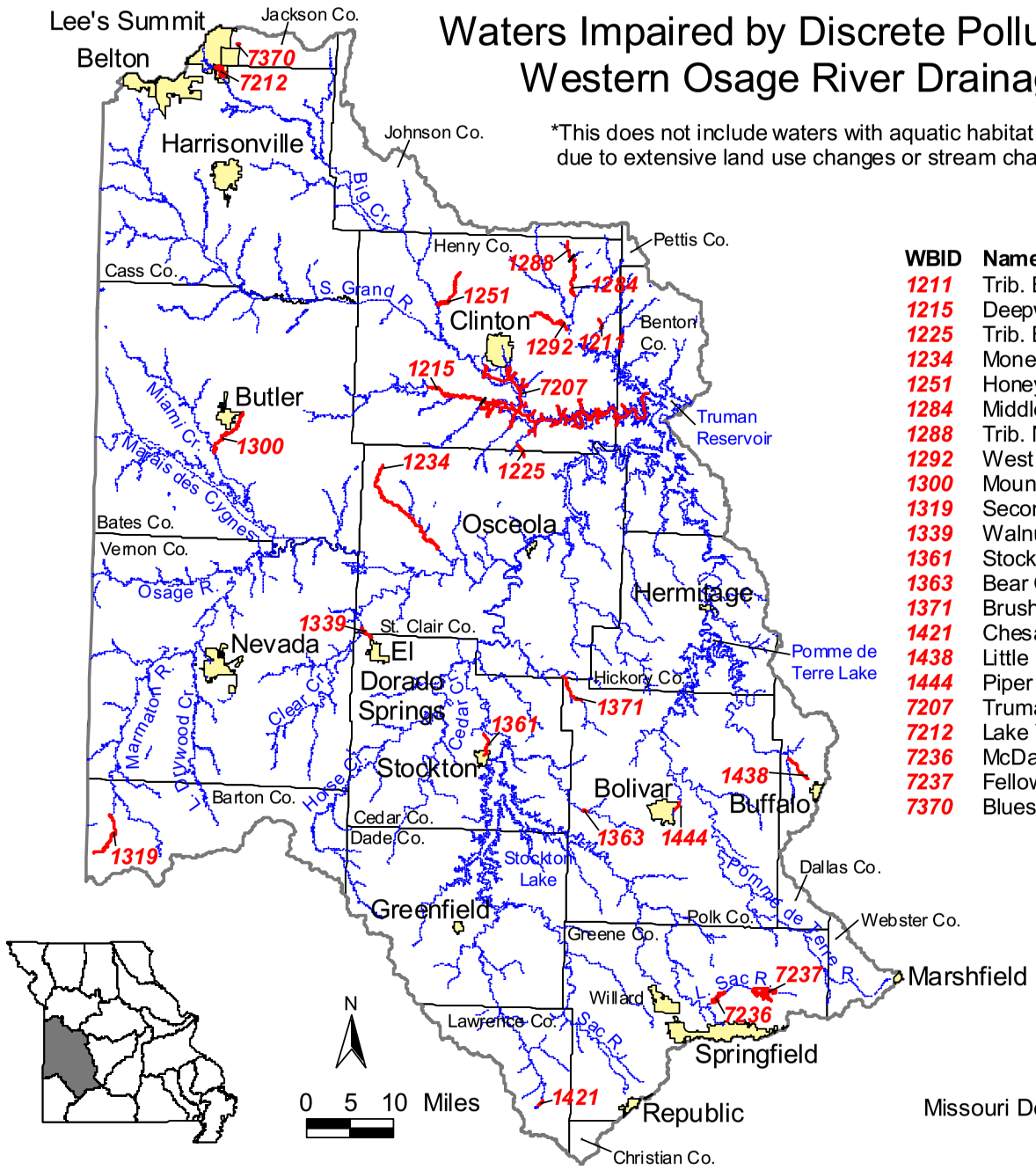
Waters Impaired by Discrete Pollutants,* Western Osage River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



Impaired Waterbody
Classified Waterbody
City Boundary
County Boundary
Drainage Boundary

WBID	Name	Pollutant
1211	Trib. Barker's Creek	low pH
1215	Deepwater Creek	low DO
1225	Trib. Big Otter Creek	low pH
1234	Monegaw Creek	Sulfate
1251	Honey Creek	Sulfate
1284	Middle Fork Tebo Creek	Sulfate
1288	Trib. Middle Fork Tebo Creek	Sulfate, low pH
1292	West Fork Tebo Creek	Sulfate
1300	Mound Branch	BOD
1319	Second Nicholson Creek	Sulfate
1339	Walnut Creek	BOD
1361	Stockton Branch	BOD, Ammonia
1363	Bear Creek	BOD
1371	Brush Creek	BOD
1421	Chesapeake Creek	NFR
1438	Little Lindley Creek	Unknown
1444	Piper Creek	BOD
7207	Truman Reservoir	Manganese
7212	Lake Winnebago	Mercury
7236	McDaniel Lake	Nutrients
7237	Fellows Lake	Mercury
7370	Bluestem Lake	Mercury

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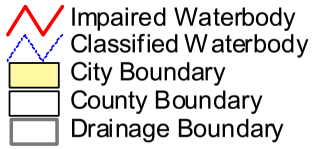
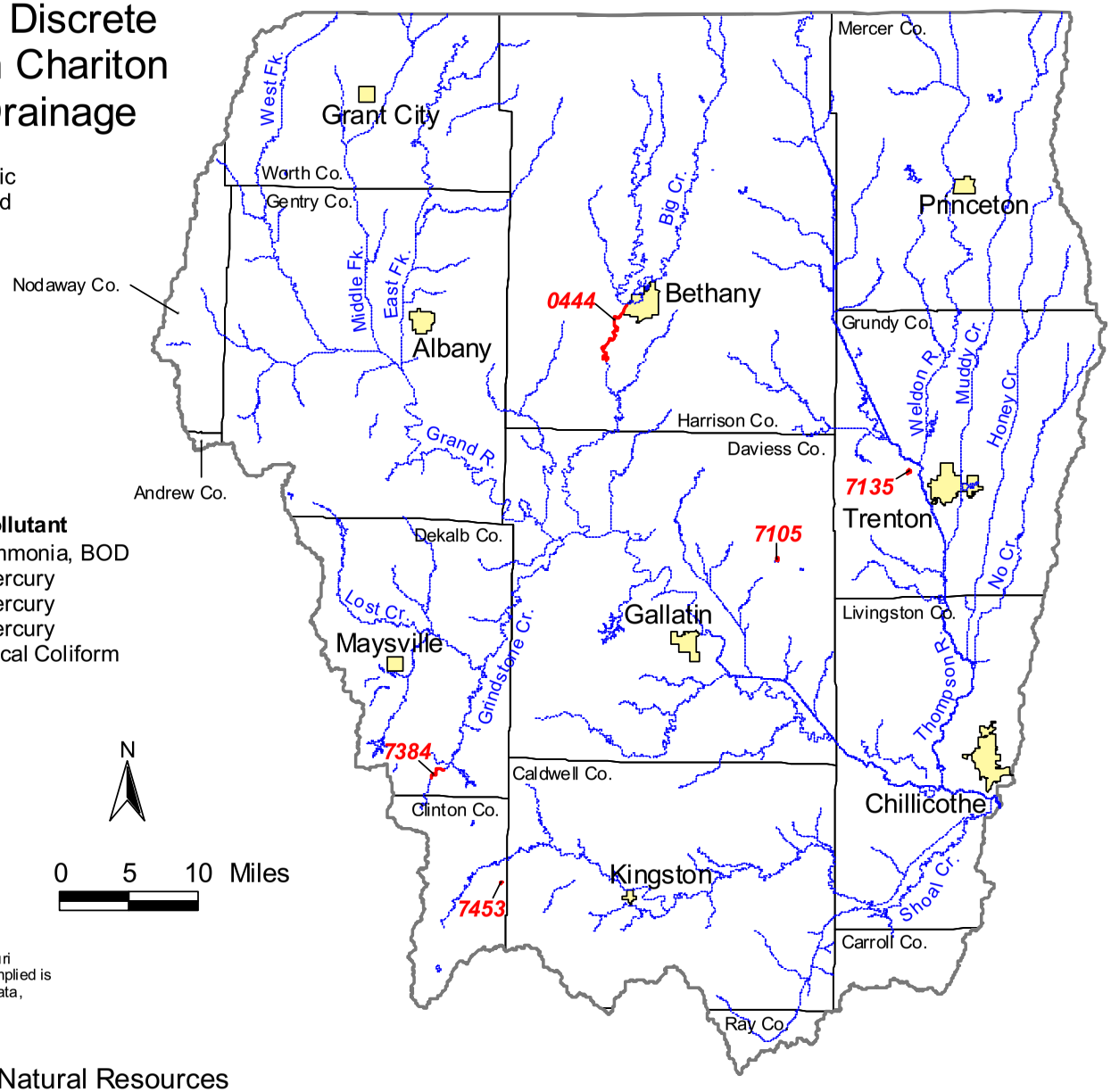
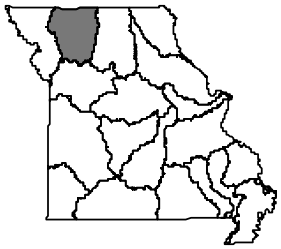
Waters Impaired by Discrete Pollutants,* Western Chariton and Grand River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.





WBID	Name	Pollutant
0444	Big Creek	Ammonia, BOD
7105	Jamesport Community Lake	Mercury
7135	Crowder State Park Lake	Mercury
7384	Grindstone Reservoir	Mercury
7435	Wallace State Park Lake	Fecal Coliform



N

0 5 10 Miles

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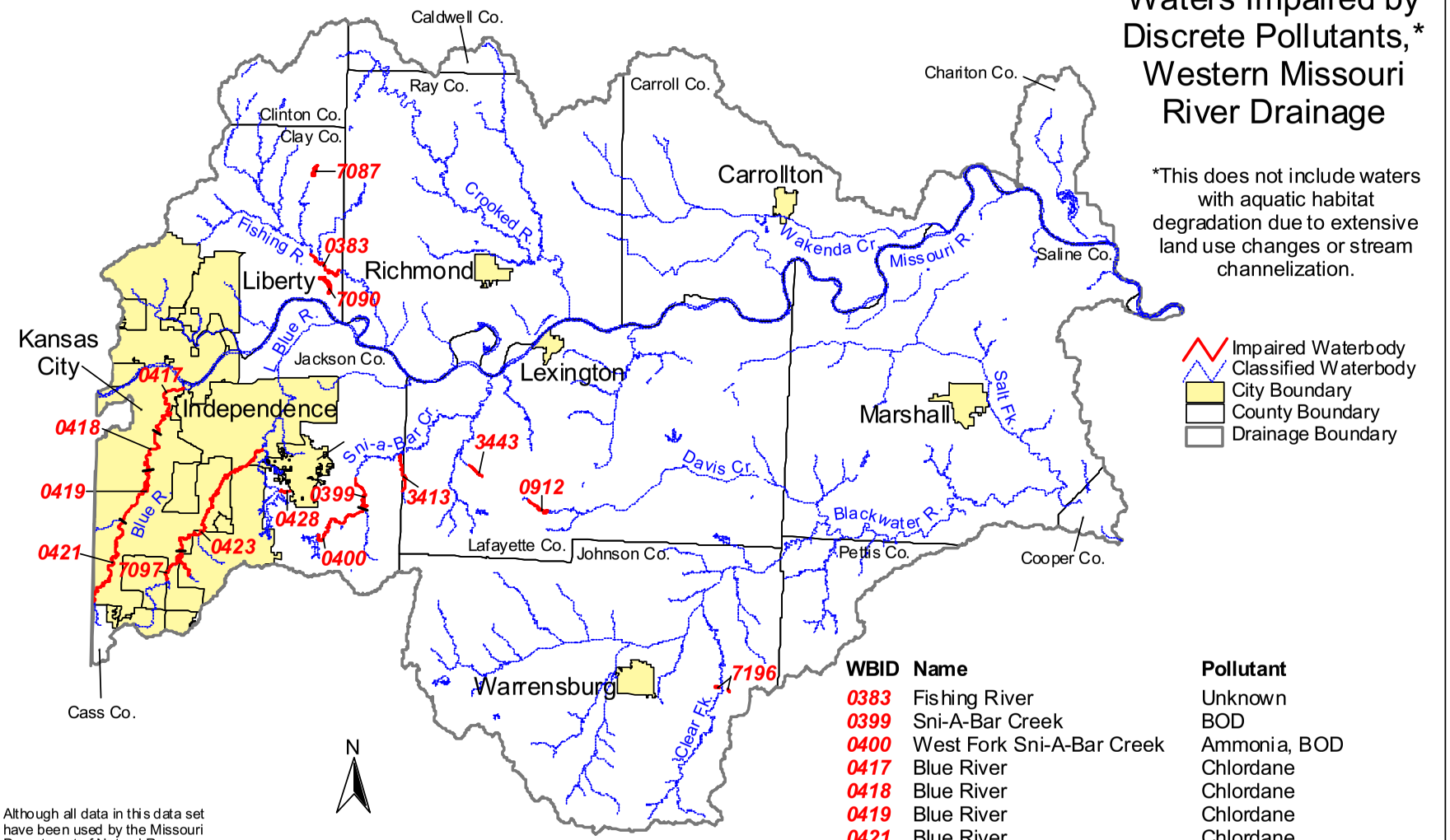
Waters Impaired by Discrete Pollutants,* Western Missouri River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
0383	Fishing River	Unknown
0399	Sni-A-Bar Creek	BOD
0400	West Fork Sni-A-Bar Creek	Ammonia, BOD
0417	Blue River	Chlordane
0418	Blue River	Chlordane
0419	Blue River	Chlordane
0421	Blue River	Chlordane
0423	Little Blue River	Mercury
0428	East Fork Little Blue River	NFR
0912	Davis Creek	Ammonia, Nutrients, BOD
3413	Horseshoe Creek	Ammonia, BOD
3443	Owl Creek	BOD
7087	Watkins Mill Lake	Fecal Coliform
7090	Cooley Lake	Mercury
7097	Longview Lake	Mercury
7196	Knob Noster State Park Lakes	Mercury

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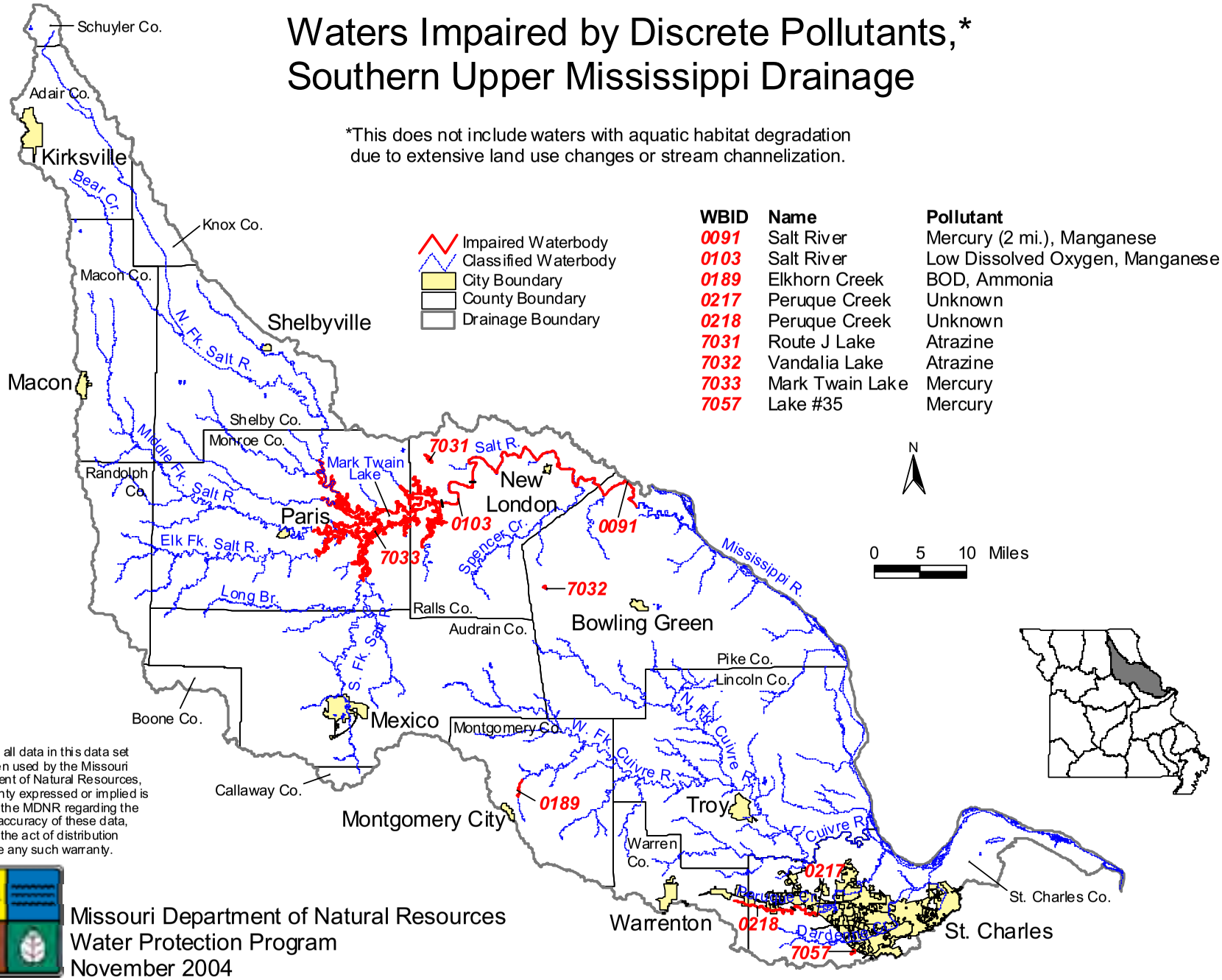
Waters Impaired by Discrete Pollutants,* Southern Upper Mississippi Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
0091	Salt River	Mercury (2 mi.), Manganese
0103	Salt River	Low Dissolved Oxygen, Manganese
0189	Elkhorn Creek	BOD, Ammonia
0217	Peruque Creek	Unknown
0218	Peruque Creek	Unknown
7031	Route J Lake	Atrazine
7032	Vandalia Lake	Atrazine
7033	Mark Twain Lake	Mercury
7057	Lake #35	Mercury



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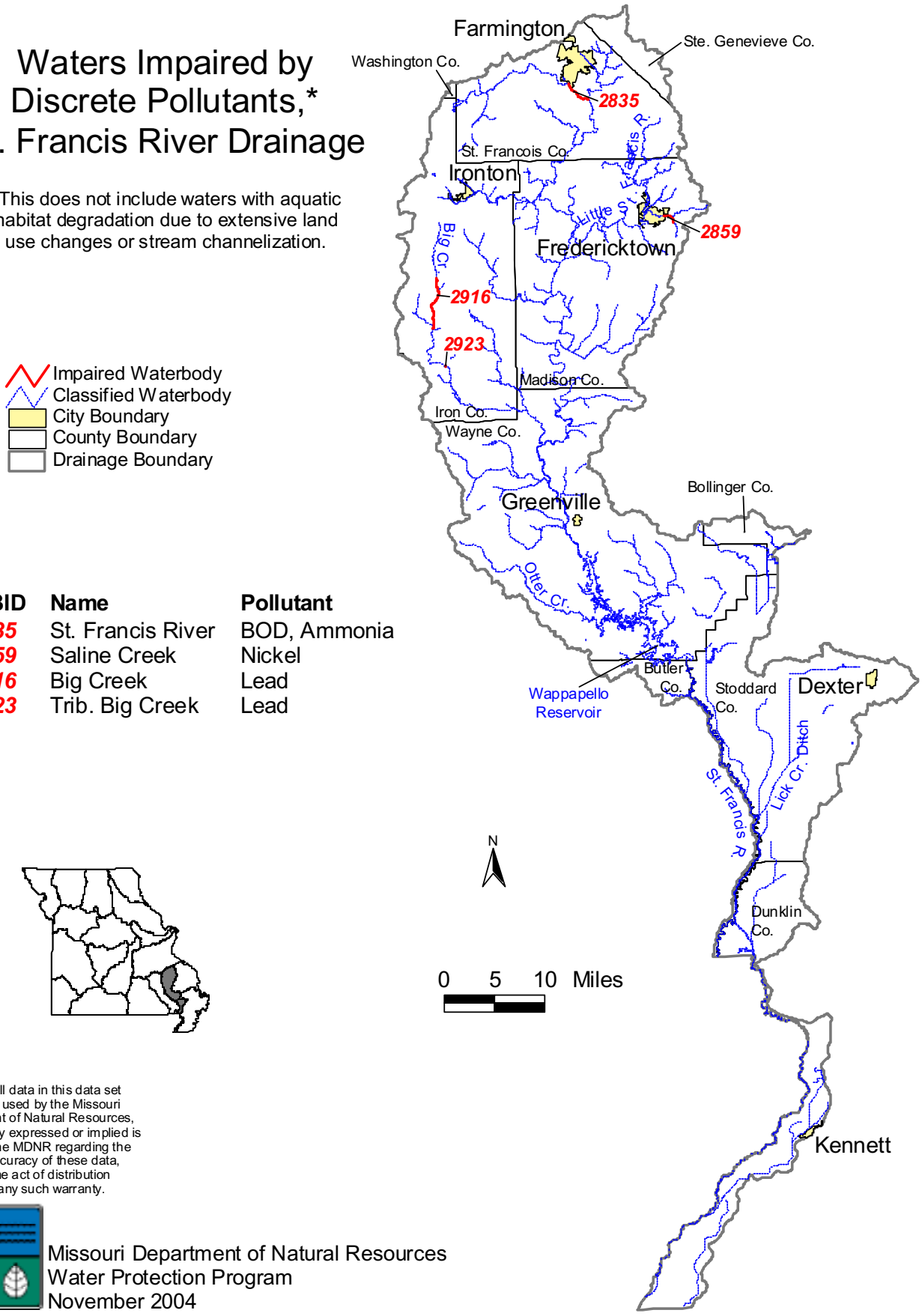
Waters Impaired by Discrete Pollutants,* St. Francis River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
2835	St. Francis River	BOD, Ammonia
2859	Saline Creek	Nickel
2916	Big Creek	Lead
2923	Trib. Big Creek	Lead

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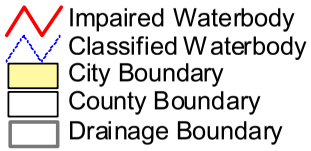
Waters Impaired by Discrete Pollutants,* Spring and Elk River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
3168	Douger Branch	Zinc
3203	Center Creek	Zinc
3216	Turkey Creek	Zinc
3217	Turkey Creek	Zinc
3230	Shoal Creek	Fecal Coliform
3239	Clear Creek	BOD
7356	Lamar City Lake	Nutrients

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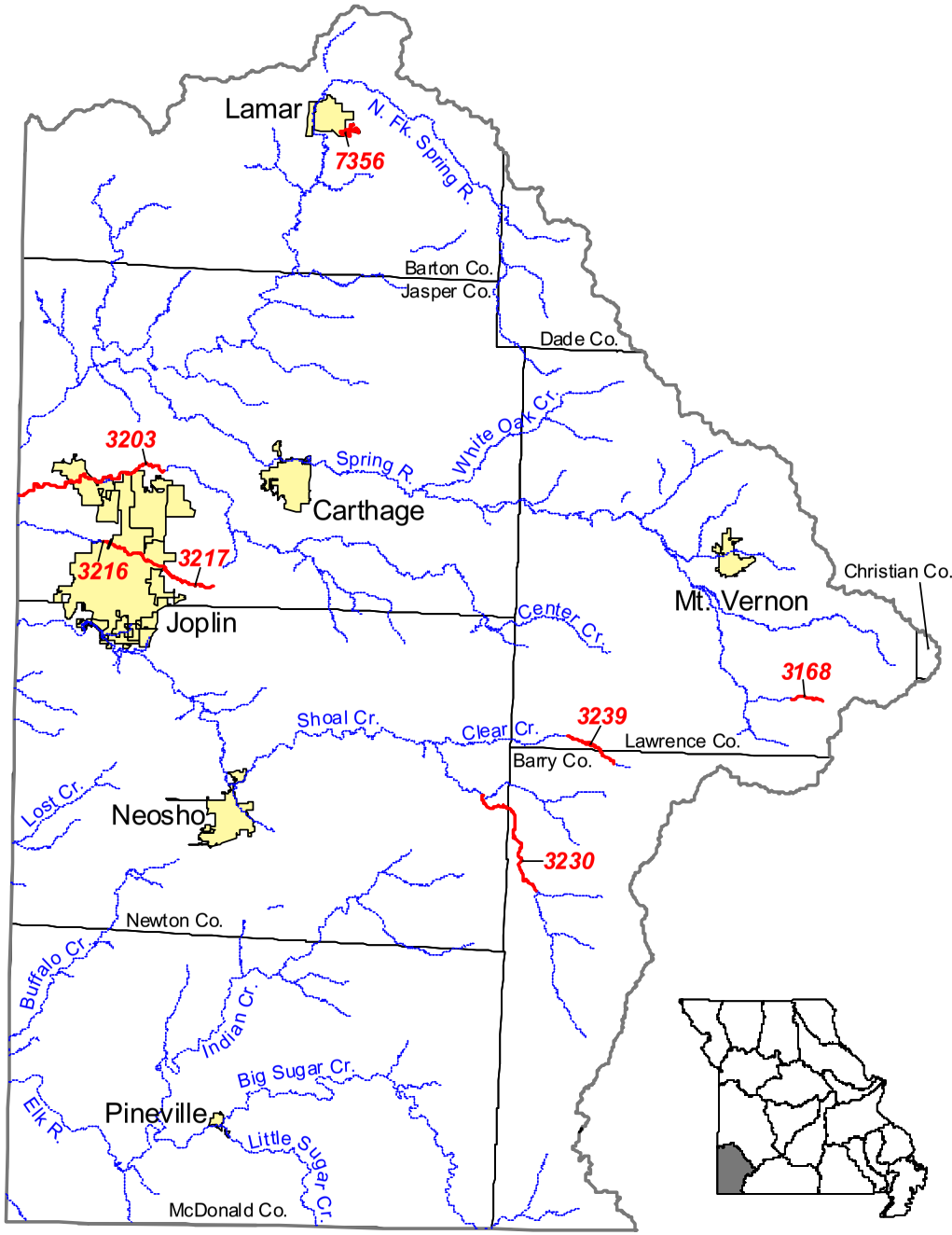

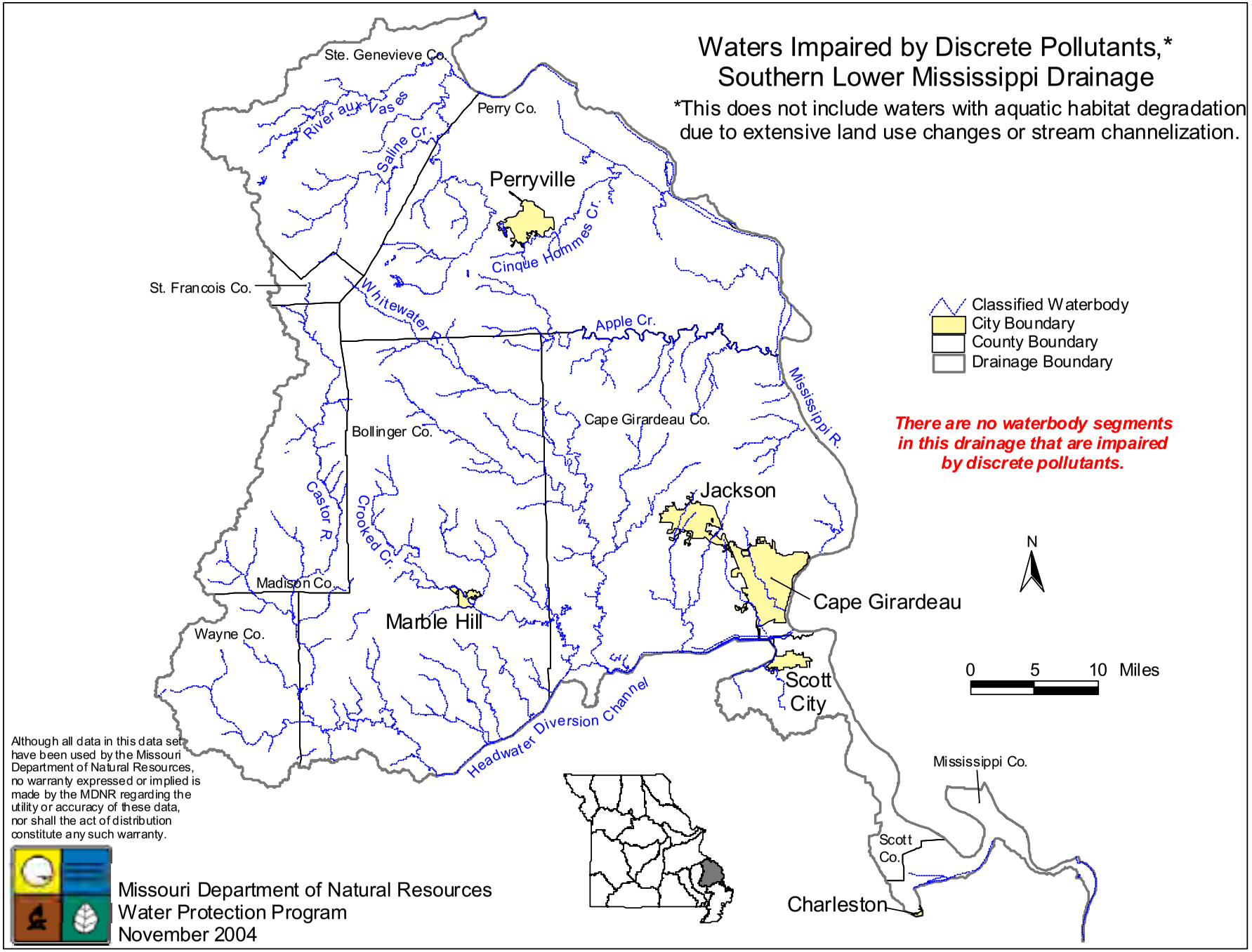
Waters Impaired by Discrete Pollutants,*
Southern Lower Mississippi Drainage
*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.
Ste. Genevieve Co.
Perry Co.
St. Francois Co.
Bollinger Co.
Cape Girardeau Co.
Madison Co.
Wayne Co.
Mississippi Co.
Scott Co.
Perryville
Jackson
Cape Girardeau
Marble Hill
Scott City
Charleston
River aux Vases
Saline Cr.
Cinque Hommes Cr.
Whitewater R.
Apple Cr.
Mississippi R.
Castor R.
Crooked Cr.
Headwater Diversion Channel
Classified Waterbody
City Boundary
County Boundary
Drainage Boundary
There are no waterbody segments in this drainage that are impaired by discrete pollutants.
N
0 5 10 Miles
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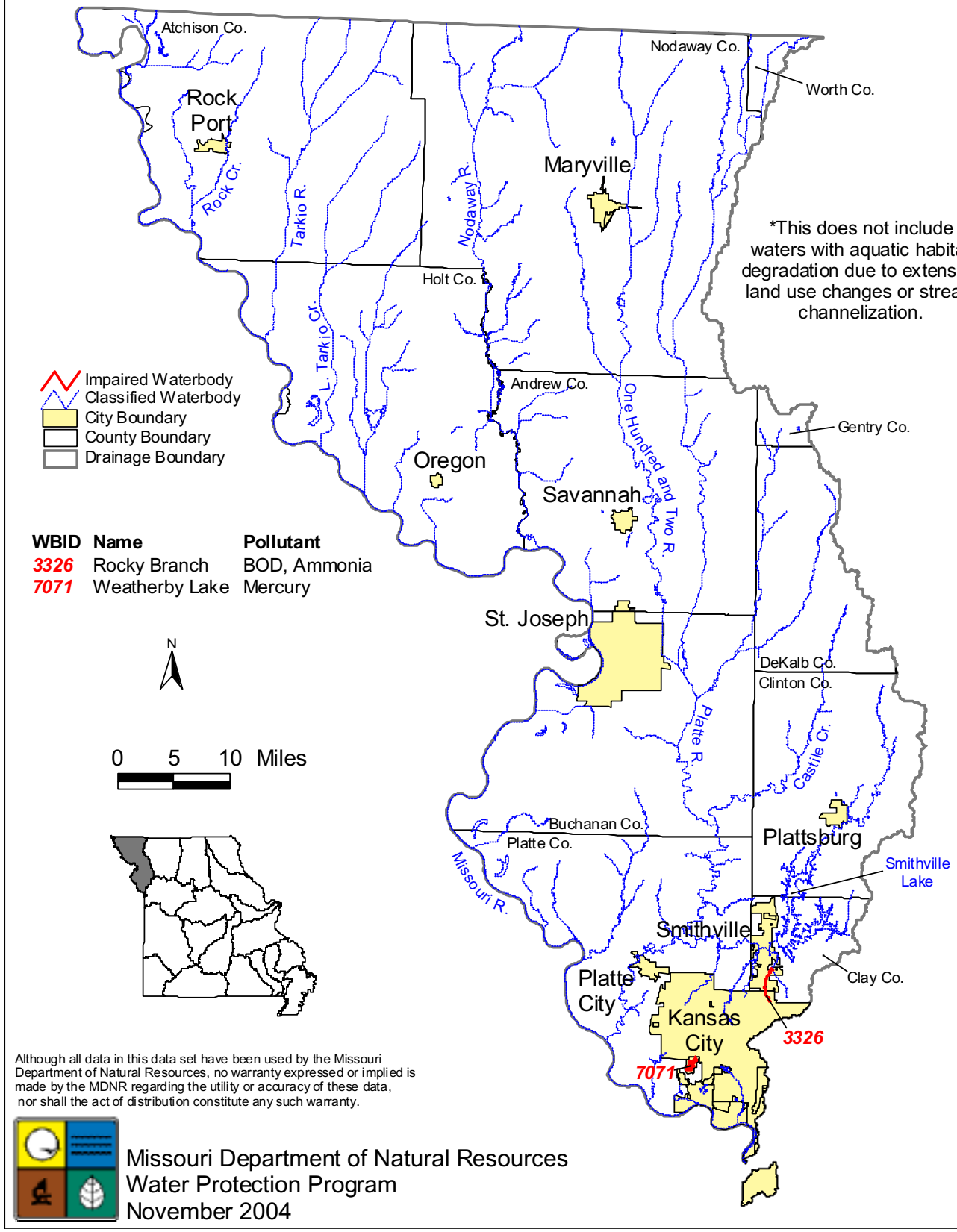
Waters Impaired by Discrete Pollutants,*
Northwestern Tributaries to Missouri River



*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
3326	Rocky Branch	BOD, Ammonia
7071	Weatherby Lake	Mercury

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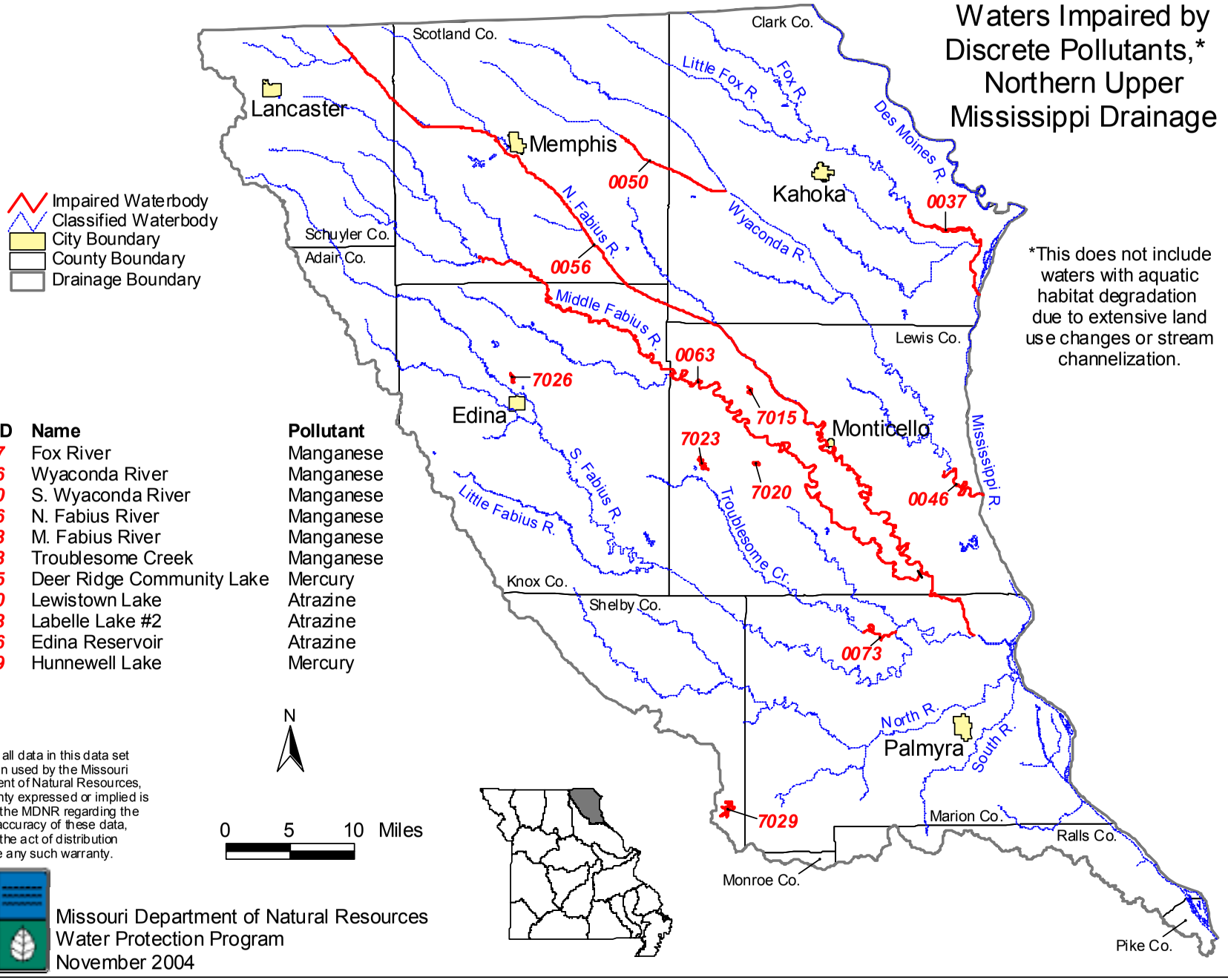
Waters Impaired by Discrete Pollutants,* Northern Upper Mississippi Drainage



*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
0037	Fox River	Manganese
0046	Wyaconda River	Manganese
0050	S. Wyaconda River	Manganese
0056	N. Fabius River	Manganese
0063	M. Fabius River	Manganese
0073	Troublesome Creek	Manganese
7015	Deer Ridge Community Lake	Mercury
7020	Lewistown Lake	Atrazine
7023	Labelle Lake #2	Atrazine
7026	Edina Reservoir	Atrazine
7029	Hunnewell Lake	Mercury

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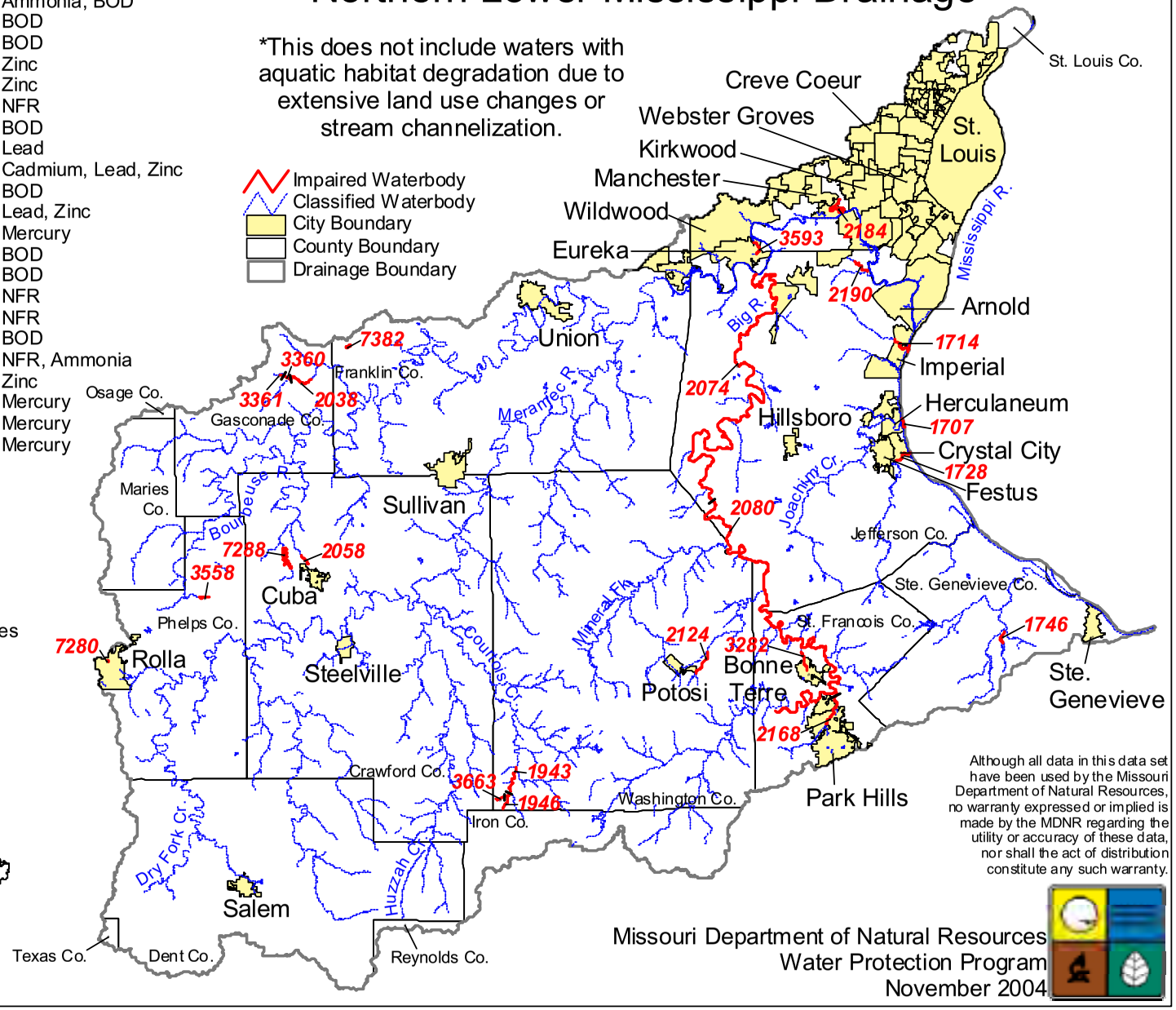
Waters Impaired by Discrete Pollutants,* Northern Lower Mississippi Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
1707	Mississippi River	Lead, Zinc (in sediment)
1714	Rock Creek	Ammonia, BOD
1728	Plattin Creek	BOD
1746	Big Bottom Creek	BOD
1943	Courtois Creek	Zinc
1946	Indian Creek	Zinc
2038	Red Oak Creek	NFR
2058	Pleasant Valley Creek	BOD
2074	Big River	Lead
2080	Big River	Cadmium, Lead, Zinc
2124	Mill Creek	BOD
2168	Flat River Creek	Lead, Zinc
2184	Grand Glaize Creek	Mercury
2190	Saline Creek	BOD
3282	Turkey Creek	BOD
3360	Trib. Red Oak Creek	NFR
3361	Trib. Red Oak Creek	NFR
3558	Robinson Creek	BOD
3593	Flat Creek	NFR, Ammonia
3663	Trib. Indian Creek	Zinc
7280	Schuman Park Lake	Mercury
7288	Indian Hills Lake	Mercury
7382	Foxboro Lake	Mercury



Missouri Department of Natural Resources
Water Protection Program
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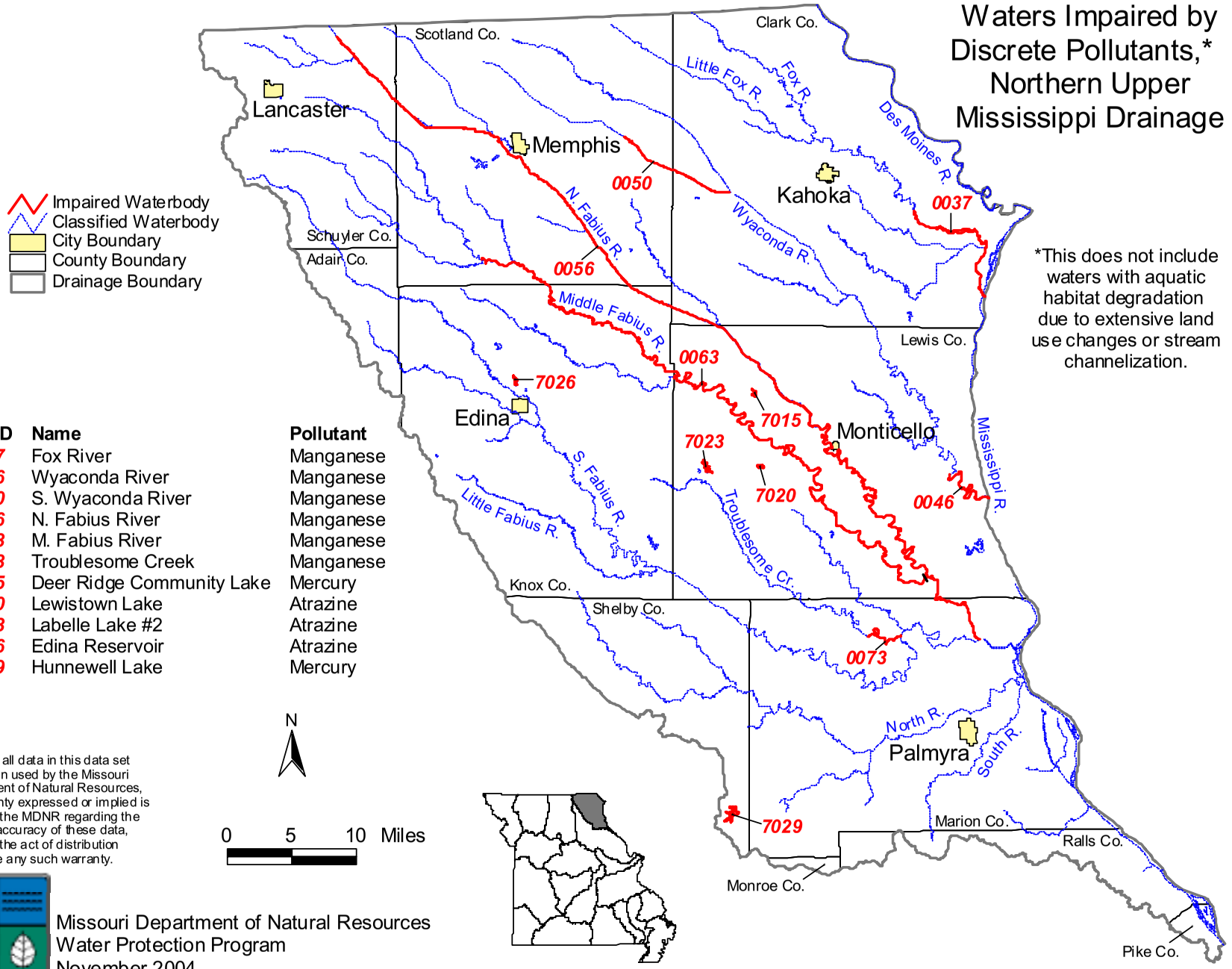
Waters Impaired by Discrete Pollutants,* Northern Upper Mississippi Drainage



*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.

WBID	Name	Pollutant
0037	Fox River	Manganese
0046	Wyaconda River	Manganese
0050	S. Wyaconda River	Manganese
0056	N. Fabius River	Manganese
0063	M. Fabius River	Manganese
0073	Troublesome Creek	Manganese
7015	Deer Ridge Community Lake	Mercury
7020	Lewistown Lake	Atrazine
7023	Labelle Lake #2	Atrazine
7026	Edina Reservoir	Atrazine
7029	Hunnewell Lake	Mercury

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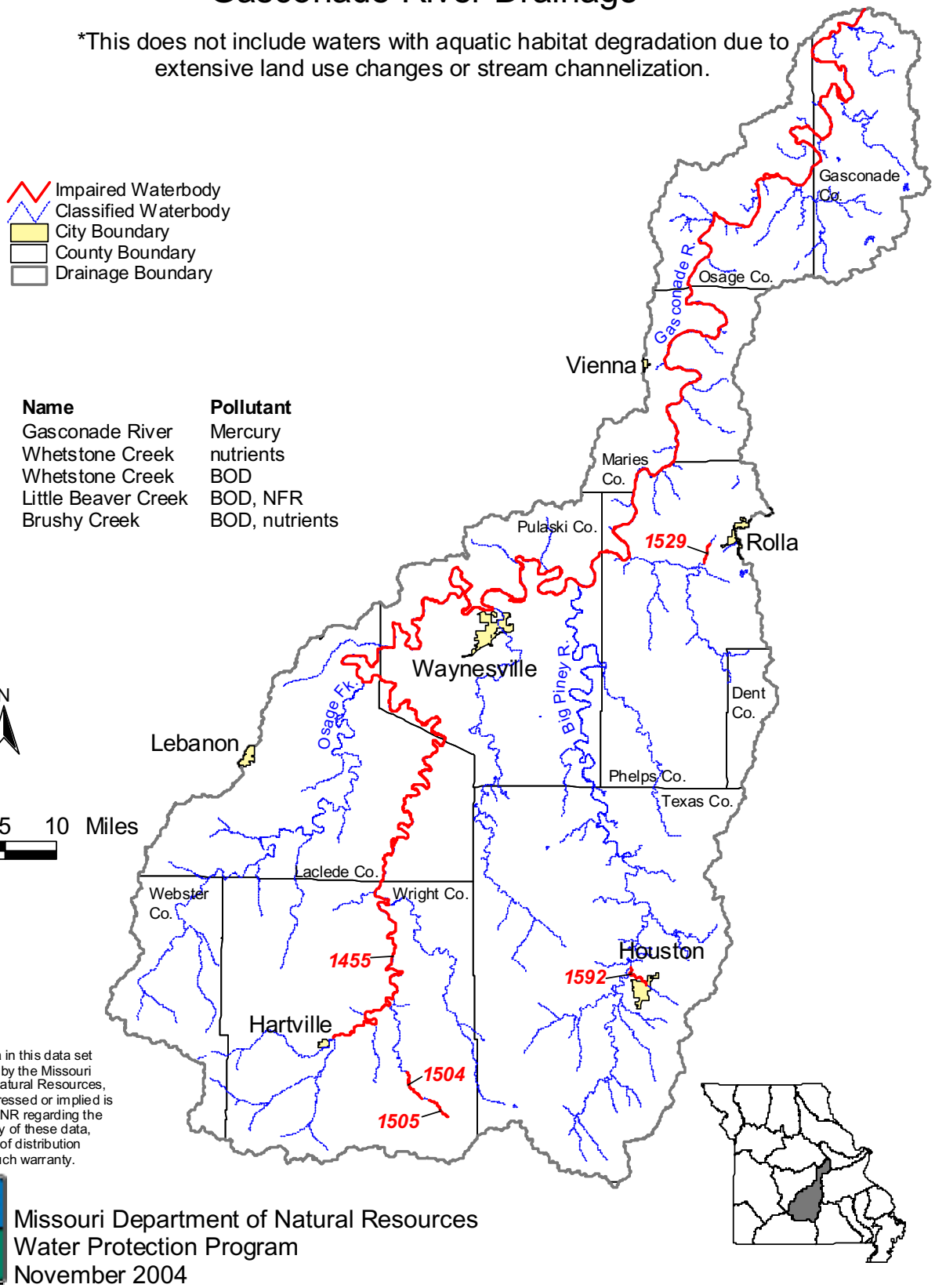
Waters Impaired by Discrete Pollutants,*
Gasconade River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
1455	Gasconade River	Mercury
1504	Whetstone Creek	nutrients
1505	Whetstone Creek	BOD
1529	Little Beaver Creek	BOD, NFR
1592	Brushy Creek	BOD, nutrients

Missouri Department of Natural Resources
Water Protection Program
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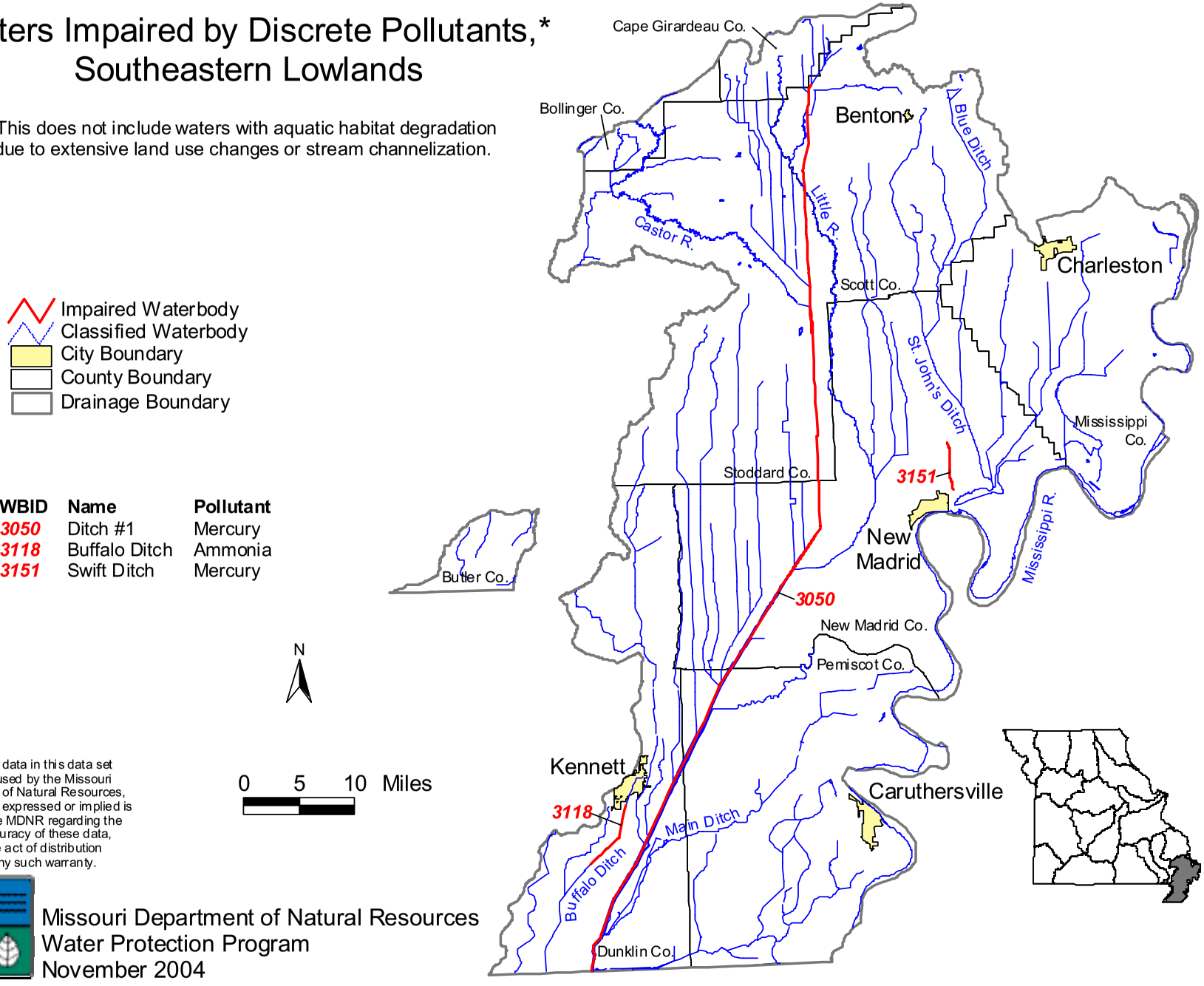
Waters Impaired by Discrete Pollutants,* Southeastern Lowlands

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
3050	Ditch #1	Mercury
3118	Buffalo Ditch	Ammonia
3151	Swift Ditch	Mercury

Missouri Department of Natural Resources
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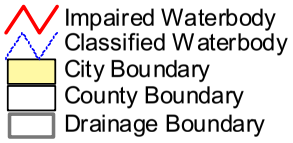
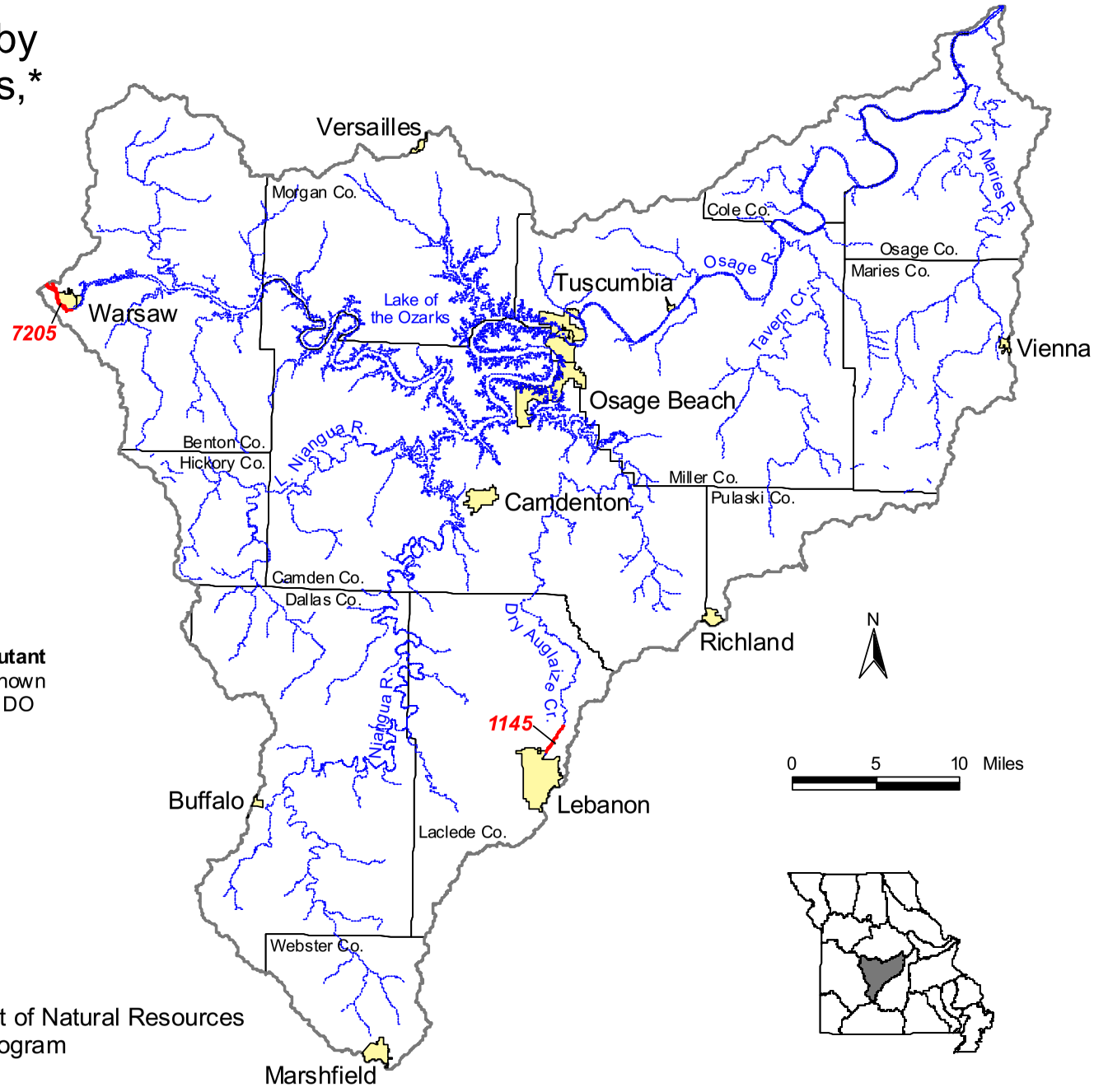
November 2004

Waters Impaired by Discrete Pollutants,* Eastern Osage River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
1145	Dry Auglaize Creek	Unknown
7205	Lake of the Ozarks	Low DO



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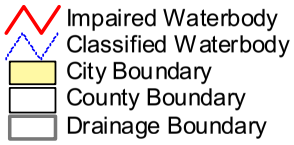
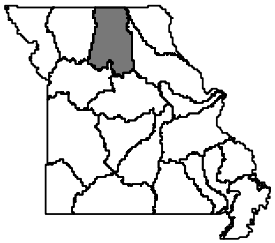
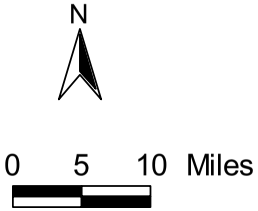
Waters Impaired by Discrete Pollutants,* Eastern Chariton and Grand River Drainage

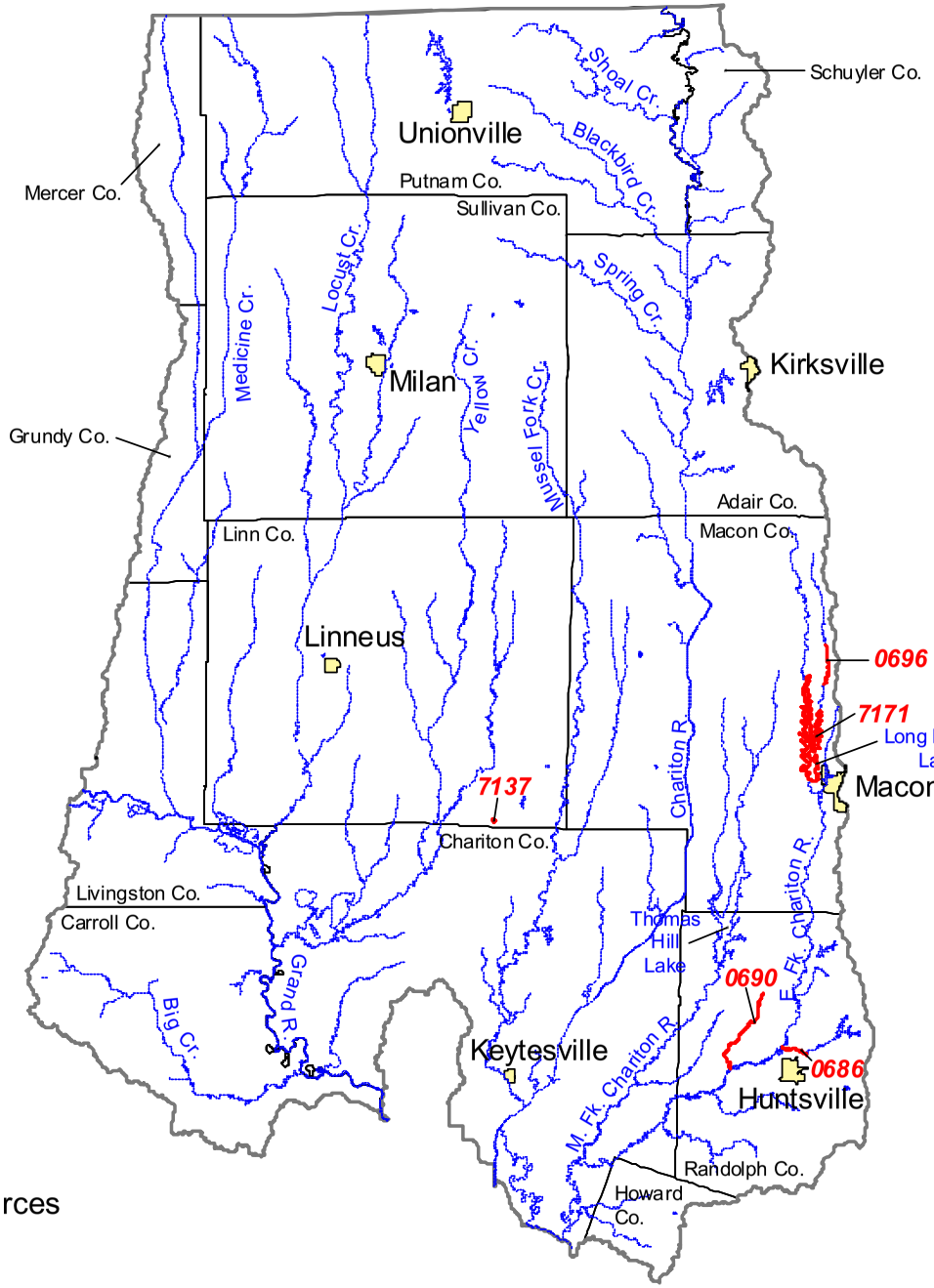
*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
0686	Sugar Creek	Low pH
0690	Dark Creek	Sulfate
0696	Long Branch Creek	BOD
7137	Walt Disney Lake	Chloride
7171	Long Branch Lake	Mercury







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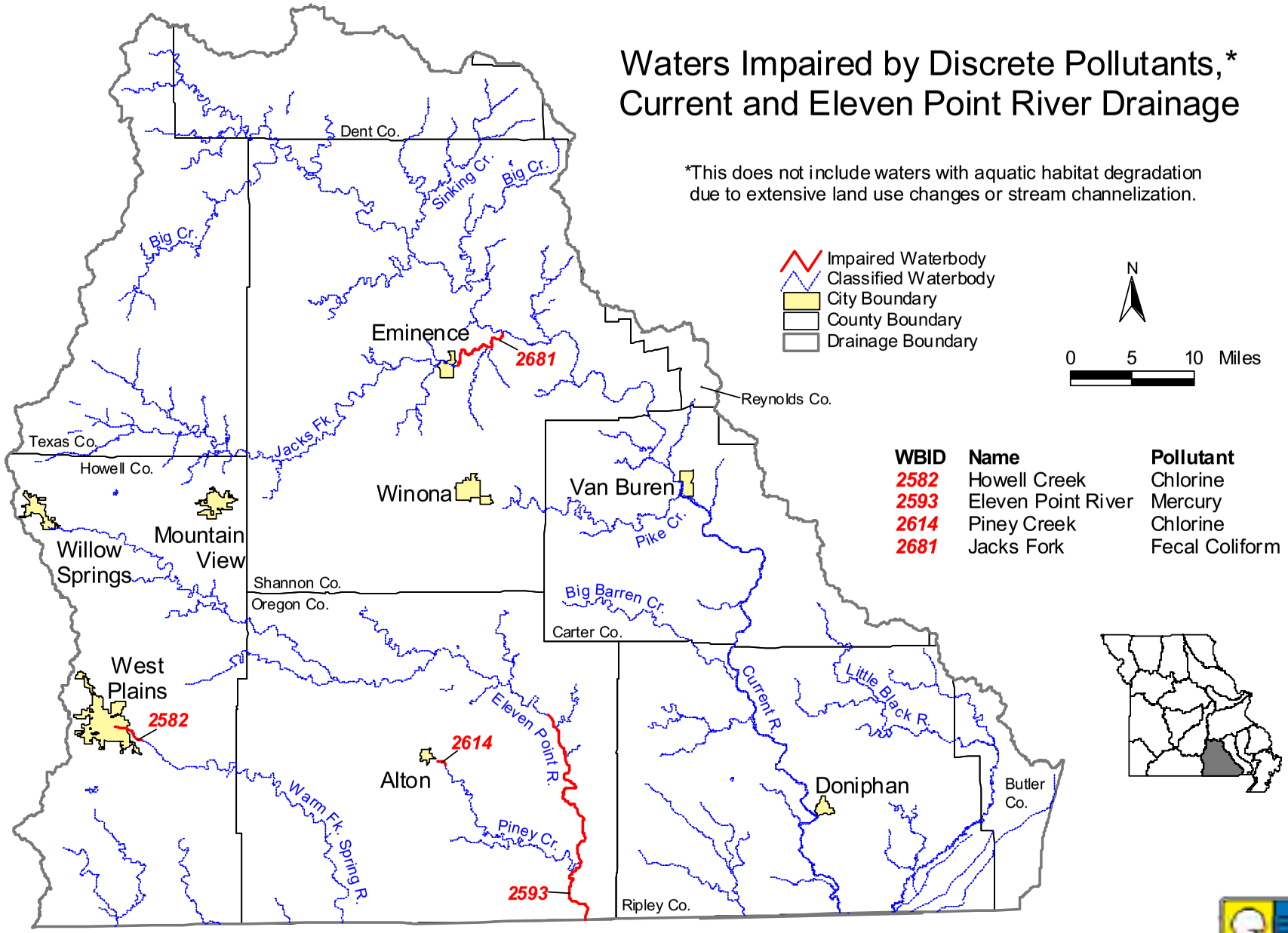
Waters Impaired by Discrete Pollutants,* Current and Eleven Point River Drainage

*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.



WBID	Name	Pollutant
2582	Howell Creek	Chlorine
2593	Eleven Point River	Mercury
2614	Piney Creek	Chlorine
2681	Jacks Fork	Fecal Coliform

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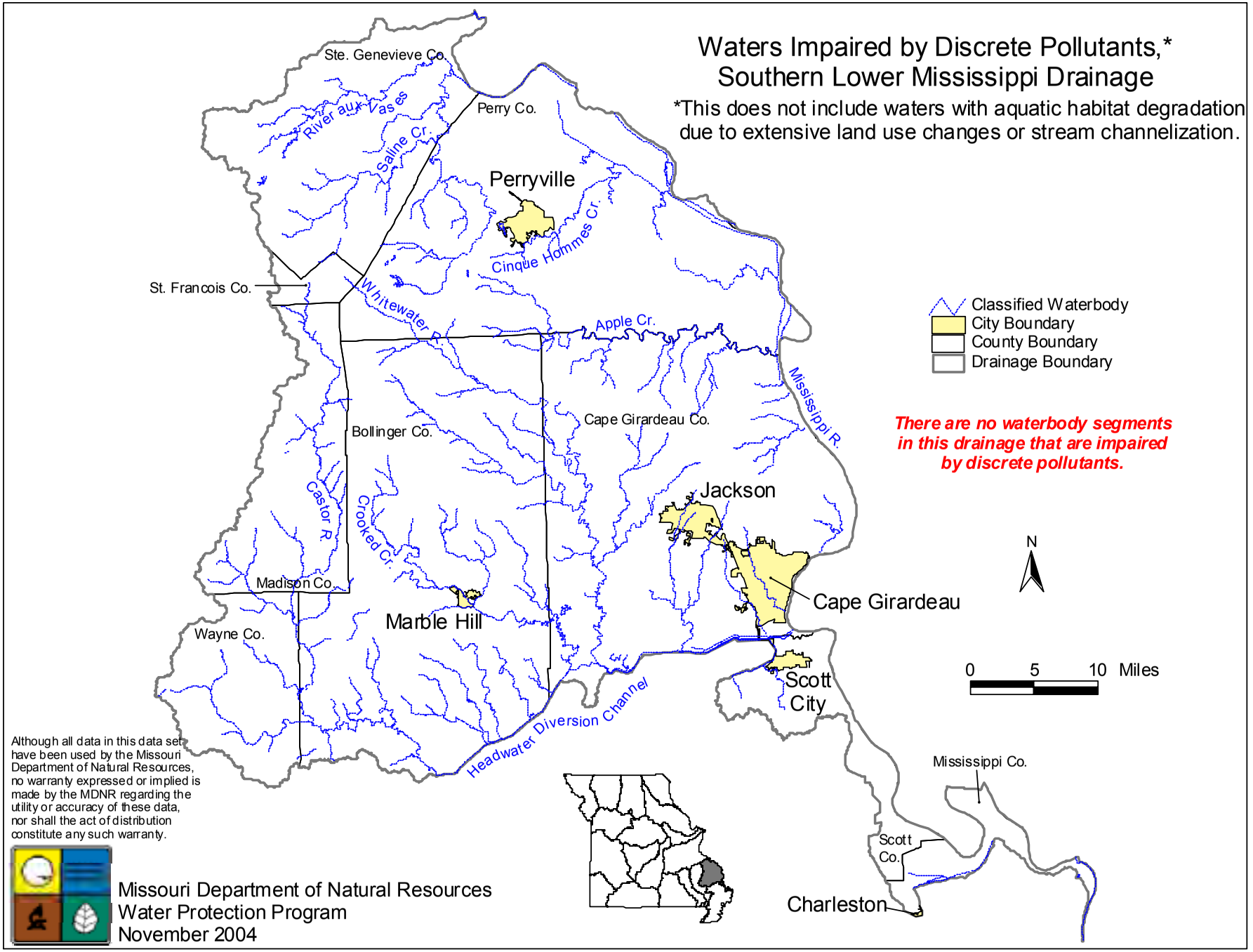
Waters Impaired by Discrete Pollutants,*
Southern Lower Mississippi Drainage
*This does not include waters with aquatic habitat degradation due to extensive land use changes or stream channelization.
Ste. Genevieve Co.
Perry Co.
River aux Vases
Saline Cr.
Perryville
Cinque Hommes Cr.
St. Francois Co.
Whitewater R.
Apple Cr.
Mississippi R.
Cape Girardeau Co.
Bollinger Co.
Castor R.
Crooked Cr.
Jackson
Cape Girardeau
Madison Co.
Marble Hill
Wayne Co.
Scott City
Headwater Diversion Channel
Mississippi Co.
Scott Co.
Charleston
Classified Waterbody
City Boundary
County Boundary
Drainage Boundary
There are no waterbody segments in this drainage that are impaired by discrete pollutants.
N
0 5 10 Miles
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